Decades of Disparity III

Ethnic and Socioeconomic Inequalities in Mortality, New Zealand 1981–1999

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Foreword

In New Zealand, as elsewhere, inequalities in health exist between ethnic groups and social classes. These inequalities are not random: in all countries socially disadvantaged and marginalised groups have poorer health, greater exposure to health hazards, and lesser access to high quality health services than their more privileged counterparts. In addition, indigenous peoples tend to have poorer health. In New Zealand the extent of these inequalities is unacceptable.

Decades of Disparity III: Ethnic and Socioeconomic Inequalities in Mortality, New Zealand 1981–1999 is the final in a series of three monitoring reports on health inequality in New Zealand over the period from 1981 to 1999 – a time of great social change in our country. The first report in this series examined ethnic inequalities in mortality, while the second investigated economic inequalities, focusing in particular on differences in survival chances between income groups. This third report analyses interactions between ethnicity and socioeconomic position in shaping survival chances. It also quantifies the extent to which ethnic inequalities in mortality are mediated by differences in socioeconomic position. Finally, the report examines trends in inequalities over the 20-year study period.

The *Decades of Disparity* series, and this third report in particular, thus provide valuable evidence in support of the Government's *Reducing Inequalities* initiative and represent an important contribution to the health inequalities debate in our country. I hope that this information will help to mobilise all sectors of government and the community – not just the health sector – to work towards greater health equity. The Ministry of Health will continue to monitor our progress towards this goal.

Comments on this report, and the monitoring of health inequality in general, are welcomed and should be sent to Public Health Intelligence, Public Health Directorate, Ministry of Health, PO Box 5013, Wellington.

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Jackie Fawcett developed many of the analytical procedures used, and contributed to the study design, analyses, interpretation of results and write-up.

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Ricci Harris contributed to the development of the theoretical framework for the analyses and provided advice on interpretation and write-up.

Natalie PakiPaki contributed to the development of the theoretical framework for the analyses and to the interpretation and write-up.

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The NZCMS is conducted in close collaboration with Statistics New Zealand. We thank the many staff of Statistics New Zealand who have contributed to the NZCMS.

Further information on the NZCMS can be found at www.wnmeds.ac.nz/nzcms-info.html.

Statistics New Zealand Security Statement

The New Zealand Census – Mortality Study is a study of the relationship between social factors and mortality in New Zealand, based on the integration of anonymised population census data from Statistics New Zealand and mortality data from the New Zealand Health Information Service.

The project was approved by Statistics New Zealand as a Data Laboratory project under the Microdata Access Protocols in 1997. The data sets created by the integration process are covered by the Statistics Act and can be used for statistical purposes only. Only approved researchers who have signed Statistics New Zealand's declaration of secrecy can access the integrated data in the Data Laboratory. For further information about confidentiality matters in regard to this study, please contact Statistics New Zealand.

(The full security statement is available at http://www.wnmeds.ac.nz/nzcms-info.html.)

Contents

List of Tables

List of Figures

Executive Summary

This monitoring report is the final in a series of three bulletins on ethnic and socioeconomic inequalities in mortality in New Zealand, covering the period from 1981 to 1999 – a time of great social change in this country. Each report employs linked mortality and census data (the New Zealand Census – Mortality Study, NZCMS) to analyse inequalities in mortality between ethnic and socioeconomic groups in New Zealand, and how these inequalities have changed over time.

The first report, *Decades of Disparity: Ethnic mortality trends in New Zealand 1980–1999* (Ajwani et al 2003), demonstrated a growing disparity in life expectancy between Māori and non-Māori throughout the 1980s and early 1990s. After correcting for under-recording of Māori ethnicity on mortality records, we found that the ethnic disparity in life expectancy at birth increased from six to seven years in the early 1980s to eight to nine years at the end of the 20th century.

The second report, *Decades of Disparity II: Socio-economic mortality trends in New Zealand 1981–1999* (Blakely, Fawcett et al 2004) explored trends in mortality by socioeconomic position, focusing mainly on income. Although all income groups experienced declines in mortality throughout the 1980s and 1990s, the difference in mortality rates between low- and high-income groups (absolute inequality) remained static, which means that relative inequality (the ratio of mortality rates in low- to high-income groups) necessarily increased over time. However, trends varied by age group: among those aged 25–44 years the difference in mortality rates between high- and low-income groups widened substantially, while for those aged 60–77 years it decreased.

Decades of Disparity III: Ethnic and socioeconomic inequalities in mortality, New Zealand 1981–1999 analyses interactions between ethnicity and socioeconomic position in shaping inequalities in mortality and the extent to which ethnic inequalities in mortality are mediated by socioeconomic inequalities. The report addresses six research questions:

1. What were the socioeconomic distributions of the Māori and non-Māori populations during the study period (1981–1999), and were there any *trends* in these distributions over time?
2. What were Māori and non-Māori mortality rates at each level of socioeconomic stratification, and how did these rates change over time?
3. What were the *inequalities* between Māori and non-Māori mortality rates at each level of socioeconomic stratification, and how did these inequalities change over time?
4. Does the association between socioeconomic position and mortality vary between Māori and non-Māori, and were there any *trends* in these associations over time?
5. What proportion of the inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was mediated by socioeconomic inequality, on average, over the study period?
6. How much of the *increase* in inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was attributable to increasing socioeconomic inequality over the study period?

Our analysis is motivated by accumulating evidence that ethnic inequalities in health reflect (in part) the unequal distribution of economic, social and political resources. Inequalities in the command over these resources are themselves rooted in historical social processes that entrench the privileged position of dominant groups (National Health Committee 1988; Robson 2004). Furthermore, given different histories, the lived reality of different socioeconomic locations is likely to be non-equivalent for Māori and non-Māori. So we cannot assume that a similar association exists between socioeconomic position and mortality across all ethnic groups. Nor can we assume that socioeconomic position alone explains all the variation in mortality between ethnic groups.

We report first on mortality rates within strata of both ethnicity and socioeconomic position, using six socioeconomic measures – income, education level, household access to a car, household tenure, labour force status, and occupational social class. We then consider the combined influence of socioeconomic factors on ethnic disparities in mortality and the extent to which these factors account for the observed increase in ethnic inequalities in mortality during the 1980s and 1990s.

Overall, we found that:

- Māori were disproportionately represented in lower socioeconomic strata (for example, lower income, no qualifications, no car access), however measured, which implies that Māori are disproportionately affected by the health consequence of lower socioeconomic status
- Māori : non-Māori inequalities in mortality persist within socioeconomic strata
- socioeconomic gradients or differences in mortality exist within both Māori and non-Māori ethnic groups
- the different socioeconomic resources or positions of the Māori and the non-Māori ethnic groups account for at least half of the ethnic disparities in mortality for working-age adults and one-third of the disparities in mortality for older adults
- widening inequalities in socioeconomic resources between Māori and non-Māori during the 1980s and 1990s explain approximately half of the widening in the mortality disparity between these ethnic groups, at least for the 25–64 age group.

Our results confirm that 'ethnicity' cannot be reduced to 'socioeconomic position' in terms of health impact. Rather, it is clear that both socioeconomic position and ethnicity (as a marker of differential experience and exposure) matter for health. Socioeconomic position and ethnicity exert both joint and independent effects on mortality through multiple pathways, and both must be addressed through health and social policy settings if health inequalities – between ethnic groups and social classes – are to be reduced and ultimately eliminated.

Introduction

Background

This monitoring report is the final in a series of three bulletins on ethnic and socioeconomic inequalities in mortality in New Zealand, covering the period from 1981 to 1999 – a time of great social change in this country. Each report employs linked mortality and census data (the New Zealand Census – Mortality Study, NZCMS) to analyse inequalities in mortality between ethnic and socioeconomic groups in New Zealand, and how these inequalities have changed over time.

The first report, *Decades of Disparity: Ethnic mortality trends in New Zealand 1981–1999* (Ajwani et al 2003), demonstrated a growing disparity in life expectancy between Māori and non-Māori throughout the 1980s and early 1990s. After correcting for under-recording of Māori ethnicity on mortality records, we found that the ethnic disparity in life expectancy at birth increased from six to seven years in the early 1980s to eight to nine years at the end of the 20th century.

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Decades of Disparity II used age and ethnicity standardisation to adjust for the effect of the changing age and ethnic composition of the New Zealand population over the study period. This allowed us to examine socioeconomic inequalities in mortality free of confounding by ethnicity, but prevented us from analysing interactions between ethnicity and socioeconomic position in shaping inequalities in mortality. Also, the extent to which ethnic inequalities in mortality are mediated by socioeconomic inequalities could not be quantified.

This third report addresses precisely these issues. More specifically, the report addresses six research questions (Box 1). The first four questions comprise the descriptive section of the report, setting the scene for the last two questions, which are more analytical.

Our analysis is motivated by accumulating evidence that ethnic inequalities in health reflect, in part, the unequal distribution of economic, social and political resources. Inequalities in the command over these resources are themselves rooted in historical social processes that entrench the privileged position of dominant groups (National Health Committee 1988; Robson 2004). Furthermore, given different histories, the lived reality of different socioeconomic locations is likely to be non-equivalent for Māori and non-Māori. Therefore we cannot assume a similar association between socioeconomic position and mortality across all ethnic groups. Nor can we assume that socioeconomic position alone explains all the variation in mortality between ethnic groups.

Box 1: The research questions

Distribution of socioeconomic factors:

Question 1: What were the socioeconomic distributions of the Māori and non-Māori populations during the study period (1981–1999), and were there any *trends* in these distributions over time?

Mortality rates:

Question 2: What were Māori and non-Māori mortality rates at each level of socioeconomic stratification, and how did these rates change over time?

Question 3: What were the *inequalities* between Māori and non-Māori mortality rates at each level of socioeconomic stratification, and how did these inequalities change over time?

Association of socioeconomic position with mortality:

Question 4: Does the association between socioeconomic position and mortality vary between Māori and non-Māori, and were there any *trends* in these associations over time?

Contribution of socioeconomic factors to disparities between Māori and non-Māori non-Pacific mortality rates:

Question 5: What proportion of the inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was mediated by socioeconomic inequality, on average, over the study period?

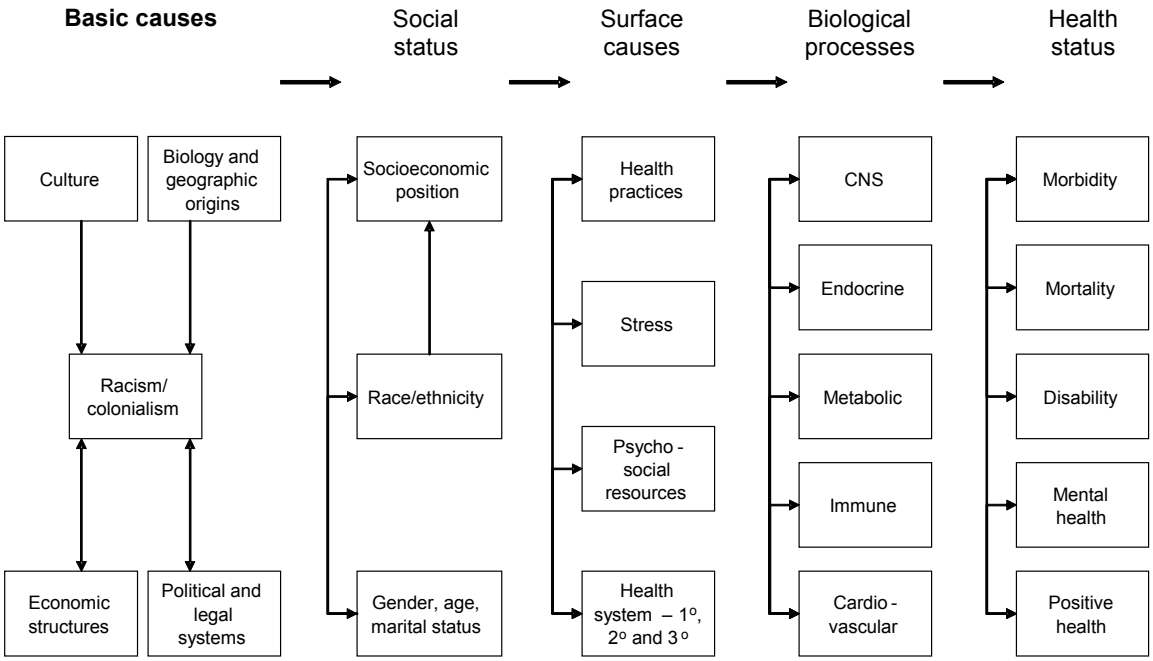
Question 6: How much of the *increase* in inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was attributable to increasing socioeconomic inequality over the study period?

Theoretical framework

Increasing ethnic inequalities in social, economic and health outcomes throughout the 1980s and 1990s have now been well documented in New Zealand (Ministry of Social Development 2004). An understanding that health outcomes, like other social outcomes, are shaped by the social, political and economic contexts in which individuals and groups live their lives is fundamental to understanding how health inequalities are produced and reproduced. It also needs to be recognised that these social outcomes reflect historical and current social processes, including racism and colonialism.

The current report adopts a framework proposed by Williams (1997) for understanding the social production of ethnic and economic inequalities in health (Figure 1).

Figure 1: Health inequalities framework



Source: Adapted from Williams 1997

In New Zealand, ethnicity is strongly related to socioeconomic position. Williams (1997) regards race (or ethnicity) as one of several social status categories that reflect power relations within society. In this framework, ethnicity is prior to socioeconomic position in the causal pathway. Socioeconomic factors are thus one pathway through which ethnic differences in health may be mediated. However, the framework identifies that this may not be the only pathway, and points to complex interactions between ethnicity and socioeconomic position that demand a more sophisticated conceptualisation of the relationship between them.

A wide variety of factors may appear to mediate between ethnicity or socioeconomic position and health outcomes. These factors include health-related and lifestyle behaviours, family stress, work and social environments, religious beliefs, personality and other psychological factors. However, these factors may be considered proximal or surface causes, because in the causal chain they are close to the health outcome. As the framework illustrates, such surface causes are not independent factors but have themselves been shaped by underlying social forces (distal or basic causes). Paying attention to the distal as well as the proximal causes can guard both against blaming the victims for their behaviour, and against analysing data in ways that reinforce deficit thinking. Also, interventions aimed at surface causes will be less effective if they do not take account of the social contexts in which vulnerable populations live. This involves understanding and representing risks and resources in ways that are meaningful for those populations.

The framework thus draws our attention to the interconnected axes of socioeconomic and ethnic stratification. It implies that ethnic inequalities in health cannot be reduced simply to socioeconomic inequalities; rather, socioeconomic position is a mediating variable. It also implies that socioeconomic inequalities cannot be comprehensively addressed without attention to the upstream drivers of structural inequality – in particular, those that produce, and reproduce, a racialised social order. Rather, the framework suggests that discrimination and socioeconomic position are closely intertwined, and both may matter for health. Quantifying the extent of this overlap for Māori and non-Māori in the 1980s and 90s is one of the major aims of this report.

Methods

New Zealand Census – Mortality Study

This report arises from the New Zealand Census – Mortality Study (NZCMS). The NZCMS is a record linkage study whereby census records have been linked to mortality records using anonymous and probabilistic linkage methods. The NZCMS is conducted collaboratively between Statistics New Zealand, the Ministry of Health and the Wellington School of Medicine and Health Sciences. It had substantial establishment funding from the Health Research Council. The study is conducted under strict privacy and confidentiality criteria, with all data securely stored onsite at Statistics New Zealand (see the security statement on page vi).

The NZCMS linkage involved linking all mortality records back to census records for the three years subsequent to the 1981, 1986, 1991 and 1996 censuses, creating four cohorts of the total New Zealand population followed for mortality for three years. The census data provide a rich source of information on socioeconomic position and other social characteristics of respondents – including their ethnicity. This makes it possible to consider variations in mortality according to a variety of socioeconomic measures and social categories, including ethnicity. Mortality information includes the cause of death, and so investigations of social variations in mortality by cause are also possible. Furthermore, each of the four census – mortality cohorts has the same study design, enabling robust comparisons to be made over time.

The information in this report covers the period from 1981–84 to 1996–99. This period is of particular interest in New Zealand because major social changes occurred, resulting in substantial widening of social inequalities.

Record linkage

The linkage process is described in detailed technical reports, published elsewhere (Blakely et al 1999; Hill et al 2002). A brief description is provided below.

Mortality records were assembled for decedents (people who have died) aged 0–74 years on the previous census night, who died within three years of the 1981, 1986, 1991 or 1996 censuses. Non-New Zealand residents were excluded, resulting in 44,932, 44,821, 41,915 and 39,665 mortality records, respectively. The NZCMS does not link mortality records for people aged 75 years and older on census night. Automatch® software was used to anonymously and probabilistically link the census and mortality data. Record linkage was conducted by staff of Statistics New Zealand under strict confidentiality arrangements. The matching variables were sex, ethnic group, date of birth, country of birth and geocode. The geocode was the most discriminatory matching variable: meshblock codes (approximately 60 households comprising 100 individuals live in each meshblock) or area unit codes (approximately 2000 people) were used. If people had changed their usual residence between census night and death, then we were unlikely to link their mortality record to a census record.

Of the eligible mortality records, 71.0%, 73.8%, 76.6% and 78.2% were linked to a census record, for the four consecutive cohorts respectively. Sensitivity calculations showed that over 96% of these linkages were correct (or 'true positive') linkages (Blakely and Salmond 2002).

Given the incomplete record linkage there was the potential for linkage bias, whereby a varying percentage of mortality records were linked by socio-demographic factors. The linkage success was less for 15–24-year-olds, and for Māori and Pacific peoples, people living in rural localities and people living in more deprived areas. However, within demographic strata of age, sex and ethnicity there was little remaining linkage bias by small-area socioeconomic deprivation (Blakely et al 2000).

Both to ensure that mortality rates calculated with NZCMS data were not underestimated, and to adjust for any linkage bias, we calculated 'weights' for each linked census – mortality record (Fawcett et al 2002). For example, if 30 out of 40 Māori male decedents aged 45–64 years from non-deprived small areas of New Zealand were linked to a census record, then we assigned a weight of 1.33 (ie, 40/30) to each of the 30 linked records. Thus, the 30 linked records were representative of the 40 decedents. This weighting process was undertaken for hundreds of strata, meaning there was unlikely to be any residual linkage bias. All analyses presented in this report use these weights.

Cohorts

The analyses presented in this report include the New Zealand resident population aged 25 to 74 years on census night. The cohort was followed for three years, and so with ageing, comprises person-years for people aged 25–77 years. The four cohorts cover the periods from 1981–84, 1986–89, 1991–94 and 1996–99.

A proportion of respondents had missing socioeconomic variables, which meant they were excluded from analyses using that variable. The proportion of missing data for each variable is detailed in the Appendix (Table A1). Table 1, below, shows the person-years of follow-up in the four cohorts for subsets restricted to respondents with non-missing age, ethnicity, sex and region[1] variables (subset A), and further restricted to respondents with non-missing socioeconomic variables (subset B).

[1] Region was defined by the four former Regional Health Authority (RHA) boundaries. These correspond roughly to the northern, central and southern North Island and the South Island.

Table 1: Person-years of follow-up according to subsets based on various exclusions

Subset	Cohort restriction	1981–84	1986–89	1991–94	1996–99
Ages 25–77 years					
A	Full cohort with sex, age or ethnic group and RHA	4,652,727	5,048,106	5,372,196	5,935,758
B	A with non-missing income, education, housing tenure and car access variables	3,301,389	3,956,241	4,439,463	4,706,973
Ages 25–59 years					
A	Full cohort with sex, age or ethnic group and RHA	3,599,851	3,924,339	4,208,424	4,722,417
B	A with non-missing income, education, housing tenure and car access variables	2,595,330	3,089,139	3,453,414	3,742,458
C	C with non-missing social class	1,362,033	1,719,408	1,805,259	2,059,413
D	C with non-missing labour force status	2,595,327	3,089,139	3,453,411	3,742,455
E	C with non-missing position in the labour market	2,553,570	3,073,689	3,421,593	3,690,948
Ages 60–77 years					
A	Full cohort with sex, age or ethnic group and RHA	1,053,082	1,123,764	1,163,772	1,213,338
B	A with non-missing income, education, housing tenure and car access variables	706,062	867,102	986,052	964,518

Note: All counts are randomly rounded to multiples of 3 according to Statistics New Zealand protocols.

Ethnicity

Ethnicity was categorised according to the 'prioritised' concept, with three categories: Māori, Pacific, and non-Māori non-Pacific. (The non-Māori non-Pacific group mainly comprises 'New Zealand Europeans'). The ethnic group was assigned as Māori if one of the three possible self-identified ethnicity responses recorded on the 1986, 1991 or 1996 censuses was Māori. Therefore, for Māori, the prioritised ethnic group represents the total Māori ethnic group (MEG). For those not allocated as Māori, the prioritised ethnic group was assigned as Pacific if one of the self-identified ethnic groups was Pacific. The remainder were assigned as non-Māori non-Pacific. In the 1981 census, those who recorded any degree of Māori ethnic origin were categorised as prioritised Māori (or MEG). Of the rest, those who recorded any degree of Pacific ethnic origin in the 1981 census were categorised as prioritised Pacific.

For the standardised mortality rates presented in this report, the comparison is between Māori and non-Māori. However, for the regression analyses, the comparison is between Māori and non-Māori non-Pacific ethnic groups.

Socioeconomic measures

Measures of socioeconomic position on the NZCMS include income, educational qualifications, housing tenure, household car access and New Zealand Deprivation Index (NZDep). For respondents in the workforce additional occupational data also enable the coding of social class and labour force status.

Equivalised household income

Income is a measure of access to resources (goods and services). The standard of living of individuals is determined by the pooled resources of the household, to which they contribute and from which they benefit. It is therefore appropriate to measure income at the level of the household – the level at which income is pooled and decisions on expenditure and consumption are made. For this reason, household income is preferred to individual income for these analyses. Household income is a composite measure based on the combined income of all persons 18 years or over living in the same household.

Households of different size and composition require different incomes to produce similar standards of living. Furthermore, there are economies of scale in households such that a household of four does not require four times the income as a household of one to purchase the same standard of living. Equivalisation is a procedure for adjusting the incomes of households to produce incomes that are comparable in terms of the resources available to family members. For these analyses, household incomes are equivalised using the Jensen Equivalisation Index.

A detailed account of the method for calculating the household equivalised income was provided in the second report in this series (Blakely et al 2004). Briefly, the New Zealand Census collects information about personal income from all respondents aged 15 or more on census night. Individual income was collected directly by 24, 16, 13 or 13 bin categories for each of the four censuses, respectively. For the 1986, 1991 and 1996 censuses, income was collected as annual gross (before personal tax) income from all sources, including benefit support, for the financial year ended 31 March in the year of the census. In 1981, income from benefits (tax free in 1981) was collected separately to income from wages and salaries (taxed) and combined to produce total personal annual income.

Each individual was assigned the median income for their income category. The personal income of all household members was then summed to produce the total household income, and the total household income was then equivalised for household economies of scale using the New Zealand-specific Jensen Index (Blakely 2002; Jensen 1988). For example, a total household income of $50,000 for a family of two adults and two children would be equivalised by dividing by 1.41 to give $35,461. Finally, the equivalised household incomes for the 1981–84, 1986–89 and 1991–94 cohorts were further adjusted for purchasing power parity to 1996 dollars, using the Consumers Price Index (CPI). Each member of the household is assigned the same value.

Equivalised household incomes were categorised in two ways. Firstly, for calculating standardised mortality rates and rate ratios, three income categories were created: low (< $26,109, CPI adjusted to 1996 and equivalised as above); medium ($26,109 to $43,016) and high (≥ $43,016). These cut points were equivalent to tertiles of income for the total 1986–89 cohort aged 25–59 years. Secondly, for the regression models, income was logged and centred on an equivalised household income of $25,000. This value was chosen as a cut point close to the median equivalised income for Māori in each census.

Highest educational qualification

The New Zealand Census collects information on the highest educational qualification gained since leaving school, or, where the respondent has no post-school qualifications, the highest school qualification. For the Māori population in particular, the distribution of highest qualifications is highly skewed, with up to 72% of males and 73% of females (in 1981) recording no qualification. Thus for the analyses in this report, a two-way classification of qualifications is used: (1) no qualification and (2) any qualification.

The proportion of the cohorts with a missing educational qualification value was generally very low, except in 1981 when 11% of females and 9% of males had missing values. However, in 1981 additional education information was collected on the highest level of *educational attendance*. For 1981 only, for those with a missing educational qualification value, it was possible to deduce the highest qualification from the level of educational attendance: 84% of people with missing values were assigned an educational level in this way.

Car access

From a socioeconomic perspective, the number of cars in a household can be viewed as a proxy measure of wealth, or as a means of accessing resources, including the labour market and social services, or as a means of social integration.

The census dwelling questionnaire includes a question about the availability, to people living at the dwelling, of motor vehicles (excluding motorbikes and scooters) for private use. The number of vehicles is collected in bin categories of 0, 1, ... 5 or more (3 or more in 1996). For the purposes of this report the number of cars is categorised as 0, 1, and 2 or more. Each member of the household is assigned the same value for car access.

Household tenure

A further measure of household wealth available on the census is household tenure. For the purposes of these analyses tenure is categorised as owned or not owned by one of the occupiers of the dwelling. All members of a household are assigned the same value for household tenure.

Occupational class

The assignment of occupational class first requires a valid occupation or job type. In the NZCMS cohorts, occupation has been coded according to at least one of three New Zealand standard classifications of occupation: NZSCO68 (all four cohorts), NZSCO90 (1991 and 1996 cohorts) and NZSCO95 (1996 cohort). Occupational class classifications are available for each of these occupational classifications (Davis et al 1999, 2004; Elley and Irving 1976). To ensure maximum comparability of the class classification across the four cohorts, we used the NZSCO68 linked Elley–Irving classification. For this report, the six Elley–Irving classes were grouped into four: classes 1+2, class 3, class 4, and classes 5+6.

The occupational class analyses are limited to ages 25–59 years because this variable is not available for most of the 60–77-year-old group, who are largely retired. In 1981, occupational information was collected on current or most recent occupation, but subsequently was collected only for people who were currently employed. As a consequence, there is a substantial amount of missing data on social class (see Table A1). Nevertheless, social class variations in mortality provide a perspective on social inequalities for the employed population.

Labour force status (LFS)

The labour force status of an individual refers to whether they participate in the formal labour force. Labour force status is derived from responses to census questions about employment status and occupation. Three categories are used in this report: in the labour force and employed, in the labour force but unemployed, and not in the labour force. To be in the labour force requires that a person is either in full- or part-time work or, if currently out of work, is actively seeking work. People may be out of the labour force for a wide range of reasons and so the make-up of this group is very diverse; for example, full-time homemakers, health and disability beneficiaries, the retired, and students.

Position in the labour market (PLM)

Because a valid social class variable is only available for those who are currently employed, it is possible to assign a position in the labour market to participants based on both social class and labour force status. Four categories were thus created: (1) in the labour force and in social classes 1–3; (2) in the labour force and in social classes 4–6; (3) unemployed; and (4) not in the labour force. The position in the labour market variable was only created for people aged 25–59 years.

New Zealand Deprivation Index (NZDep)

The New Zealand Deprivation Index (NZDep) is a measure of small-area deprivation. NZDep is a composite of deprivation at the meshblock area level. Meshblocks are the smallest geographical area defined by Statistics New Zealand. NZDep indices are available for 1991 and 1996 but not for the earlier cohorts. Hence NZDep could not be used as a measure of socioeconomic position for the analyses of trends, although the measure was used to assess the extent to which the available socioeconomic measures fully captured socioeconomic position for the 1991–94 and 1996–99 cohorts.

Sociodemographic measures

The health inequalities framework (page 3), which informs the models in this report, identifies a number of distal social, environmental and demographic forces that may influence the expression of ethnic and socioeconomic inequalities in mortality. In particular, the framework recognises geographical factors as important – including factors related to both region of residence and residential segregation (Williams 1997, 1999; Williams and Collins 1995). Within the NZCMS, no measure of residential segregation is available, but it is possible to capture geographical influences in two ways: by considering regional variations and by considering the degree of urbanisation. Marital status is also identified as a social category that influences health outcomes and may confound the associations of ethnicity, socioeconomic position and mortality.

Region

The four regional health authority areas were the geographic units of health funding and administration in the early to mid 1990s. Although since disbanded, these regions still provide a useful level of analysis for geographic variation. Despite its large sample size, the NZCMS lacks sufficient statistical power to examine smaller geographic entities such as District Health Boards, though ways of doing so are currently being developed.

Rurality

Statistics New Zealand categorises geographical areas according to population size. For the purposes of this report, areas are defined as urban or rural. Rural areas include minor urban areas (less than 10,000 population) (Statistics New Zealand 2005).

Marital status

Marital status is defined according to the legal marital status. The census distinguishes between never married, divorced/separated and widowed, although these groups are relatively small compared to the currently married group. For the purposes of this report, marital status is classified as currently married or not married.

Causes of death

In this report, standardised mortality rates and rate ratios are presented for all-cause mortality by strata of ethnicity and socioeconomic position, age and sex. Although not provided in the report, equivalent information for broad cause-of-death groups has also been published on the NZCMS webtable (http://www.otago.ac.nz/NZCMSWebTable).

Results of the regression models are also presented for major causes of death separately (Table 2). Cause of death was coded according to the ICD9 classification throughout the entire 1981–1999 period. Time trends in mortality by cause of death will therefore be unaffected by changes in ICD version. Changes in practice with regard to the recording of causes on the death certificate could still affect trends for some causes. However, broad groupings of causes of death were used, thereby limiting diagnostic, recording or coding bias.

Table 2: ICD codes

Cause of death	ICD9 codes
Cardiovascular disease	410–414, 393–409, 415–459
IHD	410–414
Cancer	140–209
Lung	162
Non-lung	140–161, 163–209
Unintentional injury	800–949
Suicide	950–959, 980–989

Analyses

Primary analyses on unit record NZCMS data were conducted in the Data Laboratory of Statistics New Zealand (eg, calculation of standardised rates, regression analyses). Secondary analyses were conducted at the Wellington School of Medicine and Health Sciences and the Ministry of Health.

Direct standardisation

To enable comparison of rates between strata defined by socioeconomic position, social categories or geographical area and ethnicity, mortality rates have been standardised by age and ethnicity using the direct method with the 1991–94 cohort as the reference population. Both the Māori and non-Māori populations are standardised to the age structure of the total 1991–94 cohort. Within the non-Māori population, however, there were increases over time in the proportion of Pacific peoples, who tend to have mortality rates intermediate between those of Māori and non-Māori non-Pacific people. Therefore, we applied an additional standardisation to the non-Māori population to adjust for this, whereby the proportion 'Pacific' within five-year age bands was the proportion of Pacific people in each band in the 1991–94 cohort.

This report makes extensive use of graphical presentations of the age-standardised rates. The actual standardised rates are presented in tables in the Appendix, and are also available in the web-based version (www.moh.govt.nz/phi or www.wnmeds.ac.nz/nzcms-info.html).

To quantify both the strength of association of socioeconomic factors with mortality within ethnic groups and, conversely, the strength of association of ethnicity with mortality within socioeconomic strata, we used both absolute and relative measures; that is, standardised rate differences (SRDs) per 100,000 person-years and standardised rate ratios (SRRs), respectively. The SRD is the difference in mortality rates for two groups (eg, low–high income). The SRR is the ratio of mortality rates for two groups (eg, low-income/high-income). We routinely calculated 95% confidence intervals for all rates, SRDs and SRRs, and these are given either in the Appendix or are available from the website (http://www.otago.ac.nz/NZCMSWebTable).

Because much of the emphasis in this report is on trends over time, we conducted statistical tests of trend on the standardised rates, SRDs and SRRs. Within strata of ethnicity, the SRRs for, say, low versus high income, were estimated by regressing the logarithm of the SRR on time period (coded as 1 for 1981–84, 2 for 1986–89, etc.). The statistical significance of the trend in the SRRs was given by the p value for time period. Regarding testing for *diverging trends* in socioeconomic inequalities within ethnic groups, we regressed the log of the SRR on the time period with an interaction term for ethnicity and time period. The statistical significance of any *divergence* in trends of the SRRs was given by the p value for this interaction term.

Poisson regression analyses

For the research questions addressing the contribution of socioeconomic factors to disparities between Māori and non-Māori non-Pacific mortality rates (ie, questions 5 and 6), it was necessary to adjust for multiple socioeconomic factors simultaneously. Therefore, we used Poisson regression on the unit-level NZCMS data.

Poisson regression models were first developed and tested on the 1986–89 cohort. Initial models included adjustments for RHA, rurality of residence and marital status, in addition to socioeconomic variables. These variables were identified as possible important confounders based on the Williams framework. The framework identifies geographic origin as one aspect of the upstream social forces that shape the ethnic and socioeconomic determinants of mortality. Marital status is also identified as a social category that shapes health outcomes. Indeed, when standardised rates and rate ratios for all-cause mortality were calculated for RHA and marital status by ethnicity, both factors were found to be associated with mortality.[2] When included in the full model, the effect of marital status was non-significant, and so in the interests of a parsimonious model, it was excluded. Rurality of residence was not associated with mortality rates.

Socioeconomic variables included in the full model were the logarithm of income,[3] education level, household tenure and household car access. For ages 25–59 years only, three additional models were run, which included social class, labour force status and position in the labour market.

The final models for the analyses were thus:

A. RHA and age
B. RHA, age, income, education, tenure and car access
C. RHA, age, income, education, tenure, car access and social class
D. RHA, age, income, education, tenure, car access and labour force status
E. RHA, age, income, education, tenure, car access and position in the labour market.

[2] The standardised rates, rate ratios and rate differences for marital status and RHA are available from the NZCMS webtable (http://www.otago.ac.nz/NZCMSWebTable/).

[3] The log of income is linearly associated with mortality rates in the NZCMS (Blakely, Kawachi et al 2004).

Models A and B were run for ages 25–77 years and for age groups 25–59 and 60–77 years. Models C, D and E were restricted to ages 25–59 years. For the 1991–94 and 1996–99 cohorts, we also ran additional models that included small-area socioeconomic deprivation (ie, NZDep).

The contribution of the socioeconomic variables to the total RR for Māori relative to the non-Māori non-Pacific ethnic group was calculated as the proportional decrease in the excess RR between models A and B. Hence if the RR was 2.0 according to model A and 1.5 according to model B, then the proportion of the total RR attributable to socioeconomic position was (2.0–1.5)/(2.0–1) = 50%. Corresponding calculations were performed to calculate the additional contribution of social class, labour force status and position in the labour market.

In addition to examining trends in the proportion of Māori : non-Māori non-Pacific RR attributable to socioeconomic position, the effect of time period was examined using a pooled analysis. The cohorts were pooled and the regression models were run with the addition of a time period covariate, which was modelled as a continuous variable. An interaction term for time period and ethnicity was included. A positive value for the interaction term represented the increase in the RR for Māori compared to non-Māori over one inter-cohort period (five years).

Trends in Inequalities

This chapter addresses the first four (largely descriptive) research questions (Box 2), for each socioeconomic factor in turn. That is, all four questions are addressed first in relation to income, followed by education, housing tenure, car access, labour force status and finally occupational social class.

Box 2: Research questions addressed in this chapter

Question 1: What were the socioeconomic distributions of the Māori and non-Māori populations during the study period (1981–1999), and were there any *trends* in these distributions over time?

Question 2: What were Māori and non-Māori mortality rates at each level of socioeconomic stratification, and how did these rates change over time?

Question 3: What were the inequalities between Māori and non-Māori mortality rates at each level of socioeconomic stratification, and how did these inequalities change over time?

Question 4: Does the association between socioeconomic position and mortality vary between Māori and non-Māori, and were there any *trends* in these associations over time?

Key results only are presented in this chapter. More detailed results, including mortality rates by cause of death, are available in the Appendix and on the website (http://www.otago.ac.nz/NZCMSWebTable).

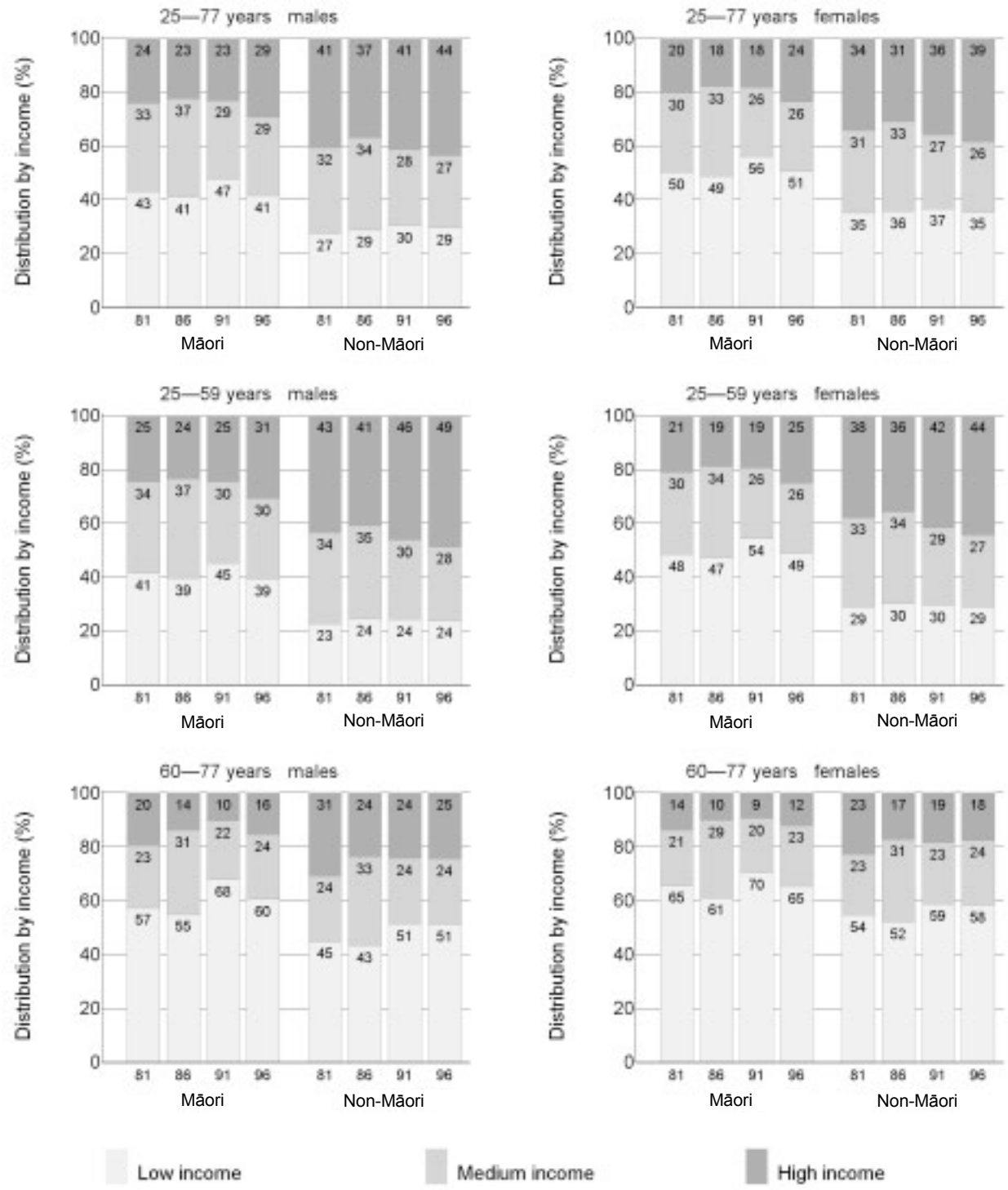
Income

Income distribution

Figure 2 shows the distribution of each cohort by income level (high, medium, low), ethnicity (Māori, non-Māori), age and sex.

- Throughout the study period, in all age-by-sex strata, non-Māori were more concentrated in higher income bands than Māori.
- Differences in income distribution between Māori and non-Māori were greater for males than for females, and also greater at younger ages.
- For both Māori and non-Māori, a higher proportion of females than males, and of people aged 60–77 years compared to 25–59 years, were in the low-income groups.

Figure 2: Distribution of population, by income level, ethnicity, cohort, sex and age group



Note: The numbers in each block are the actual percentages.

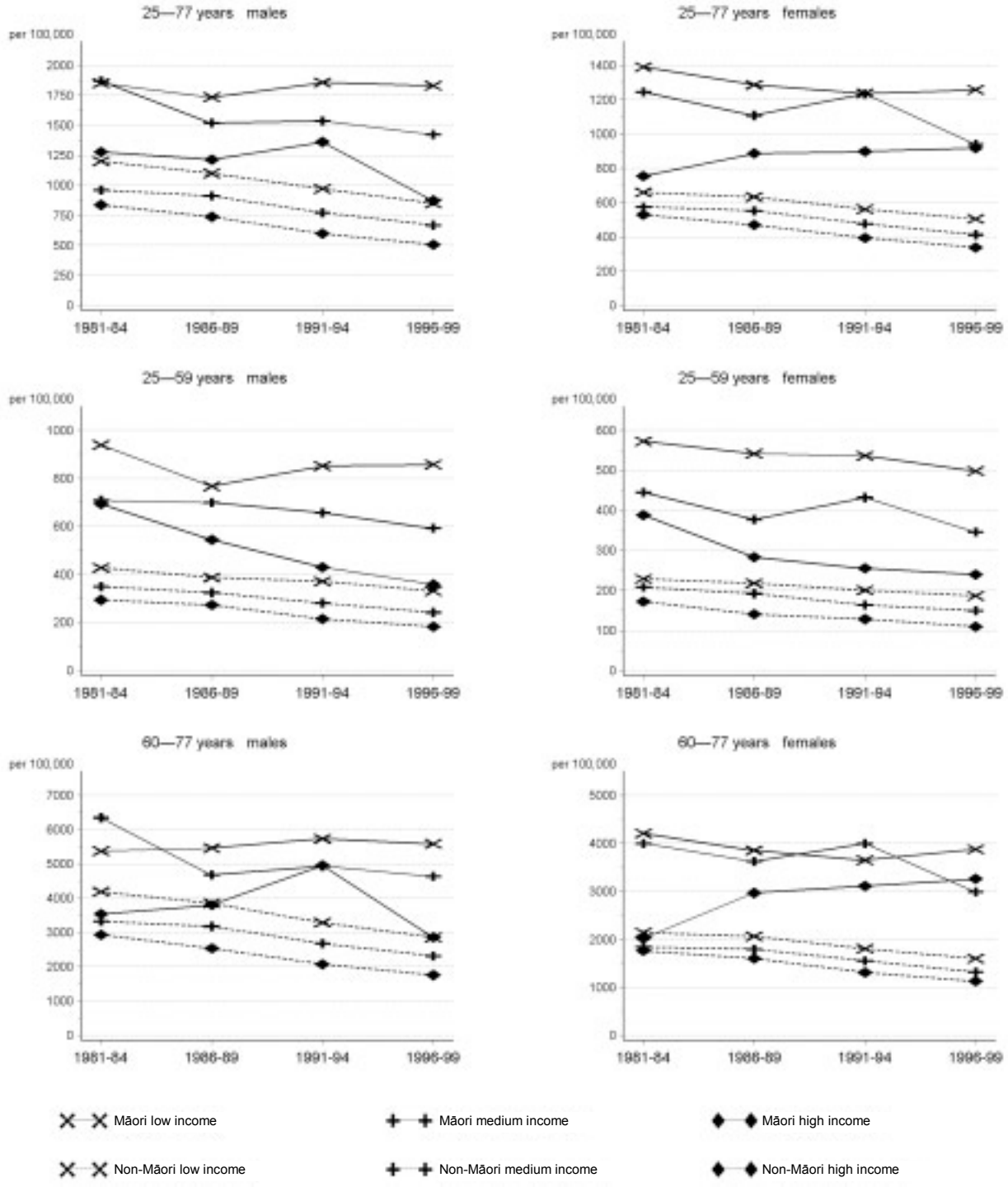
Mortality rates, by income level

Figure 3 shows the all-cause mortality rates for Māori and non-Māori, by income level (high, medium, low) across each cohort, by age and sex.

- Throughout the observation period, within each income group, Māori experienced higher all-cause mortality rates than non-Māori. That is, disparities in mortality between Māori and non-Māori persist within income groups.
- For people aged 25–59 years, the mortality rates for Māori with high incomes were similar to, or higher than, mortality rates for non-Māori in the low-income group.
- Among non-Māori, mortality declined from 1981–84 to 1996–99 within all income groups. However, among Māori, only the high-income group experienced a definite decrease in mortality – and then only among those aged 25–59 years. Changes over time for other age-by-sex-by-income groups among the Māori population were not statistically significant (see Tables A2 and A3 in the appendix for confidence intervals).
- The absolute differences[4] between Māori and non-Māori mortality rates were, in general, smaller in the high- than in the medium- or low-income groups. Although trends were difficult to discern because of wide confidence intervals, the difference between Māori and non-Māori mortality rates declined significantly for high-income males aged 25–59 years: from 399 (CI 271–527) per 100,000 in 1981–84 to 176 (CI 117–235) per 100,000 in 1996–99.
- Within each ethnic group and cohort, mortality rates were higher at lower levels of income. However, the absolute mortality disparity between low- and high-income groups did not increase significantly over the observation period. The one exception to this pattern was for Māori aged 25–59 years, for whom the SRD for high- compared to low-income groups increased.
- Because the Māori population is distributed more towards lower income levels, the proportion of Māori affected by the income – mortality relationship is greater than for non-Māori.

[4] Standardised rate differences (SRD).

Figure 3: Mortality rate trends from 1981–84 to 1996–99 for cross-classified groups of ethnicity, by income, cohort, sex and age group



Note: Actual mortality rates (and 95% confidence intervals) represented in this figure are shown in Tables A2 and A3 in the Appendix.

Is the relationship between income and mortality different for Māori and non-Māori?

Table 3 shows the SRRs for low- compared with high-income groups,[5] by ethnicity and cohort.

- Within the same cohort, Māori and non-Māori SRRs are generally not significantly different: in almost all age and sex strata, the confidence intervals overlap. The overall conclusion is that income mortality gradients are similar for Māori and non-Māori when measured on a *relative* scale. However, it should be noted that the *absolute* differences in mortality rates between low- and high-income groups were larger for Māori than for non-Māori, as shown in the previous section.
- Over time, there was a trend for the SRR to increase among males (both Māori and non-Māori) and among non-Māori females. However, wide confidence intervals make interpretation of trends difficult for Māori females.
- Among 25–59-year-old males the p value of the test to compare trends for Māori and non-Māori was 0.08, suggesting a possibly greater increase for Māori. Among females aged 60–77 years, the SRR decreased among Māori but increased for non-Māori, again suggesting a possible difference in trend ($p = 0.06$). However, neither p value was less than 0.05.

In summary, there is little evidence that relative inequality in mortality by income is different for Māori compared with non-Māori. Over time, the increase in SRR may have been greater for Māori among 25–59-year-old males only, but the differences in trend did not quite reach conventional levels for statistical significance.

[5] That is, the ratio of the age-standardised mortality rates of the low income to the high income group.

Table 3: SRR (95% CI), by income level, cohort, sex, ethnicity and age group

Sex	Age	Cohort	Low- to high-income group SRR (95% CI)		P value for difference in trend*
			Māori	Non-Māori	
Males	25–77 years	1981–84	1.45 (1.15–1.82)	1.43 (1.37–1.51)	
		1986–89	1.43 (1.11–1.84)	1.49 (1.42–1.57)	
		1991–94	1.36 (1.02–1.83)	1.63 (1.55–1.71)	
		1996–99	2.09 (1.69–2.59)	1.68 (1.59–1.77)	
		P (trend)	0.059	<0.001	0.345
	25–59 years	1981–84	1.36 (1.08–1.70)	1.46 (1.33–1.59)	
		1986–89	1.41 (1.12–1.78)	1.42 (1.30–1.55)	
		1991–94	1.98 (1.60–2.45)	1.73 (1.59–1.89)	
		1996–99	2.40 (1.97–2.91)	1.82 (1.66–1.99)	
		P (trend)	0.001	0.001	0.085
	60–77 years	1981–84	1.52 (1.05–2.19)	1.43 (1.35–1.51)	
		1986–89	1.44 (0.99–2.09)	1.52 (1.43–1.62)	
		1991–94	1.16 (0.79–1.70)	1.58 (1.49–1.68)	
		1996–99	1.95 (1.44–2.63)	1.62 (1.52–1.73)	
		P (trend)	0.414	0.009	0.738
Females	25–77 years	1981–84	1.84 (1.34–2.53)	1.25 (1.16–1.33)	
		1986–89	1.45 (0.98–2.16)	1.35 (1.26–1.45)	
		1991–94	1.38 (0.95–1.99)	1.42 (1.33–1.52)	
		1996–99	1.37 (1.00–1.87)	1.49 (1.39–1.60)	
		P (trend)	0.270	0.001	0.072
	25–59 years	1981–84	1.48 (1.11–1.97)	1.33 (1.19–1.49)	
		1986–89	1.91 (1.43–2.57)	1.55 (1.39–1.74)	
		1991–94	2.10 (1.61–2.74)	1.57 (1.41–1.74)	
		1996–99	2.08 (1.65–2.62)	1.70 (1.53–1.88)	
		P (trend)	0.169	0.012	0.802
	60–77 years	1981–84	2.08 (1.28–3.40)	1.22 (1.12–1.32)	
		1986–89	1.30 (0.77–2.19)	1.29 (1.18–1.40)	
		1991–94	1.17 (0.73–1.88)	1.37 (1.27–1.49)	
		1996–99	1.19 (0.81–1.75)	1.42 (1.30–1.55)	
		P (trend)	0.149	0.014	0.059

* The difference in trends between Māori and non-Māori was tested by regressing the logarithm of the SRR on time period, with an interaction term for ethnicity and time. The test of difference is the probability of the chi-square statistics for the interaction term (see Methods, page 13).

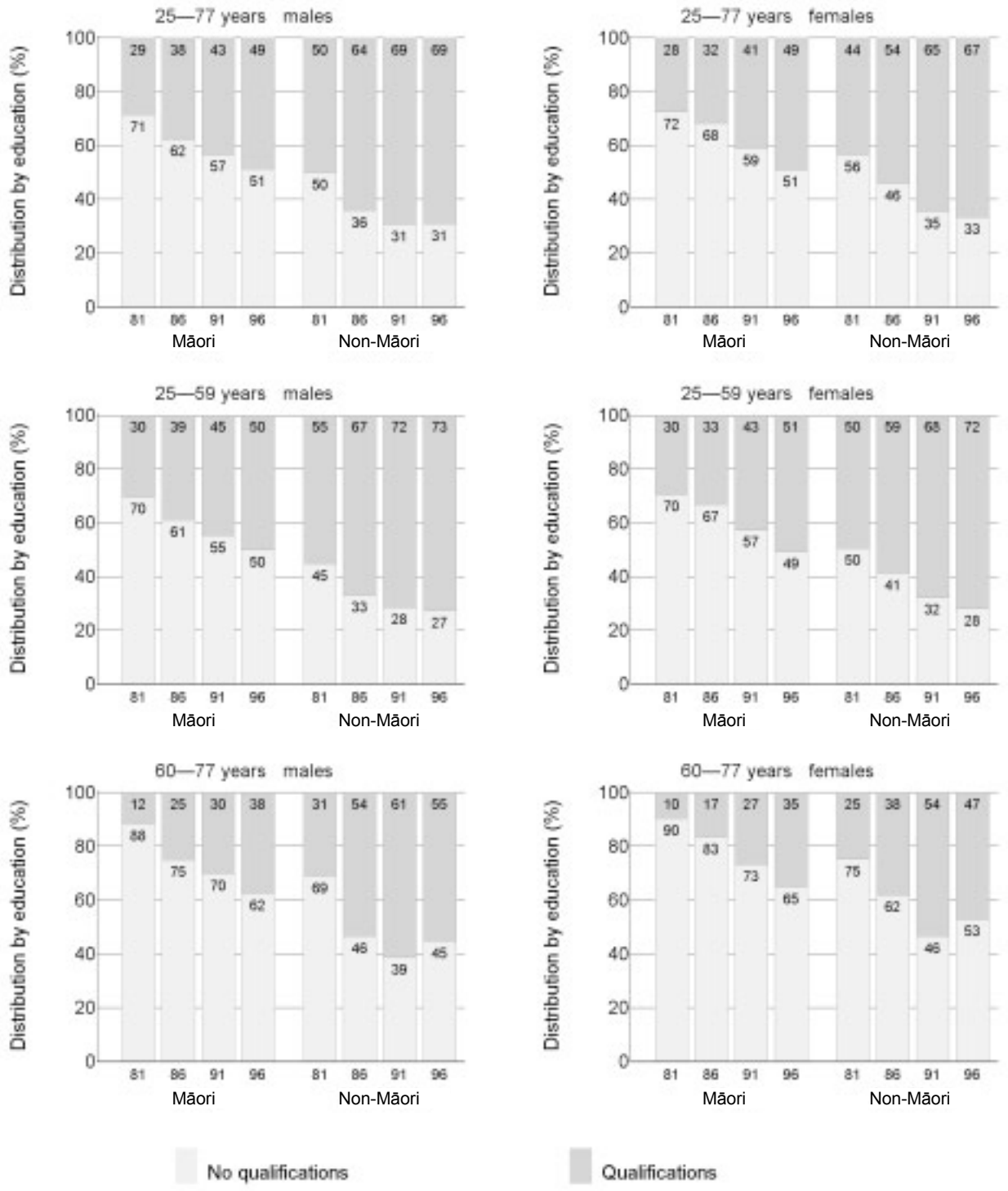
Education

Population distribution, by education level and ethnicity

Figure 4 shows the distribution of each cohort, by education level.

- For all ethnic groups, the proportion of the cohort composed of people with qualifications increases markedly over time. As a result, from earlier to later cohorts, the proportion of the cohort exposed to the higher mortality rate associated with low educational status (no qualifications) decreases progressively.
- The proportion of people with qualifications is greatest for the non-Māori ethnic group in all age-by-sex strata in every cohort.

Figure 4: Distribution of population, by education level, ethnicity, cohort, sex and age group



Note: The numbers in each block are the actual percentages.

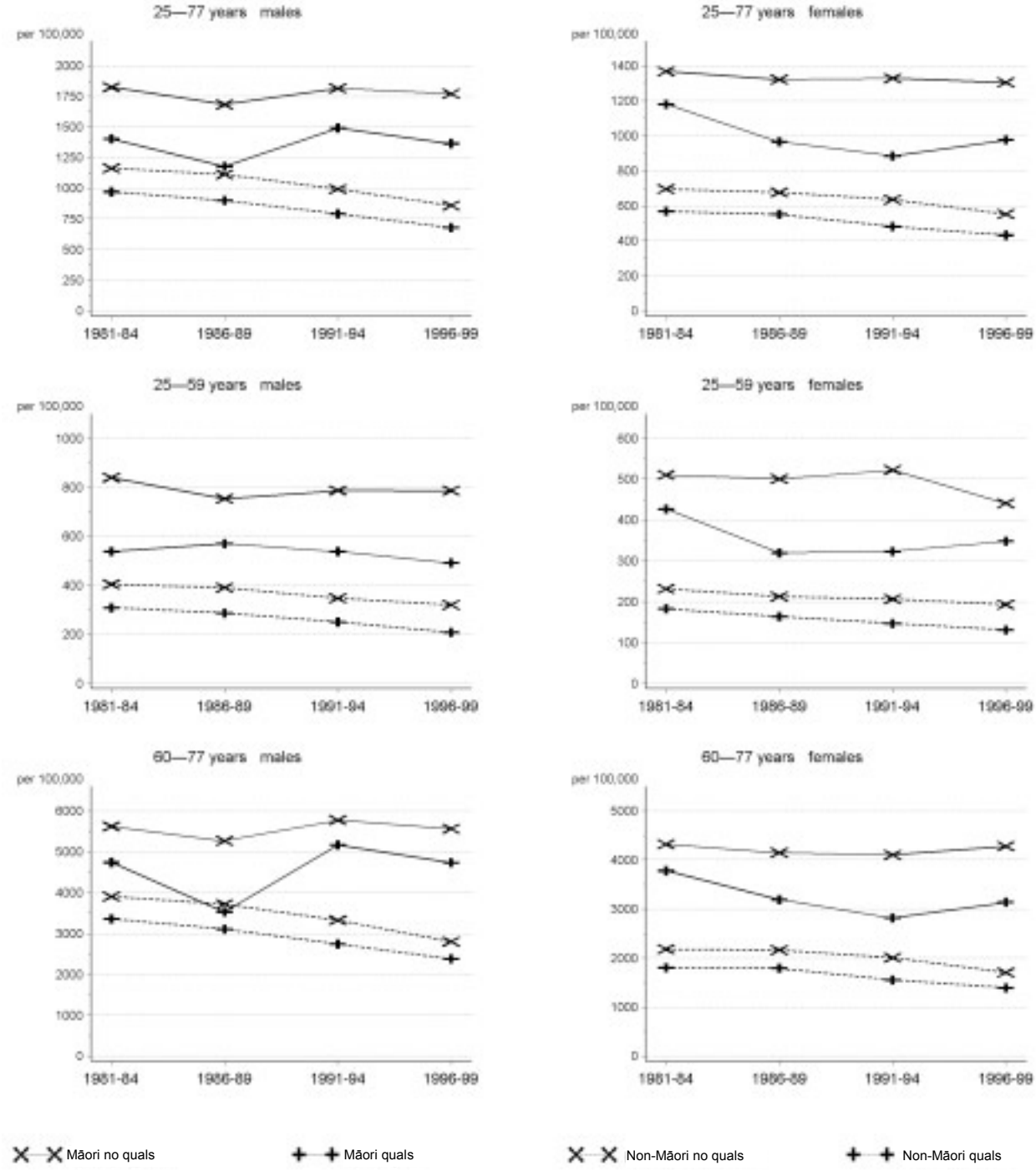
Mortality rates, by education level and ethnicity

Figure 5 shows mortality rates for each cohort, by education level,[6] sex and age group.

- Within each ethnic group, those with educational qualifications have lower mortality rates than those without. That is, education level is associated with mortality for both Māori and non-Māori.
- Throughout the observation period, and within each education category, Māori experienced higher all-cause mortality rates than non-Māori. That is, ethnic mortality inequalities persist within strata of education.
- In general, Māori with educational qualifications have higher mortality rates than non-Māori without qualifications.
- In all age-by-sex strata, the difference between Māori and non-Māori mortality rates is greater for people with no qualifications compared to those with qualifications. There is also a tendency for the difference in mortality rates between Māori and non-Māori to be greater in the later cohorts, for both education categories.
- Among non-Māori, both education groups showed consistent declines in mortality rates over time. By contrast, among Māori there was no improvement in mortality for those without qualifications, and only an inconsistent and not statistically significant decrease for those with qualifications.

[6] That is, the ratio of mortality rates of people with no qualifications to those with qualifications.

Figure 5: Mortality rates, by education level



Note: actual mortality rates (and 95% confidence intervals) represented in this figure are shown in Table A5 in the Appendix.

Is the relationship between education level and mortality different for Māori and non-Māori?

Table 4 shows the SRR comparing people with no qualifications to people with qualifications,[7] by ethnicity and cohort.

- Within each cohort, the SRRs for Māori and non-Māori are of similar magnitude, with overlapping confidence intervals in all instances. Hence, when education is used as a measure of socioeconomic position, there is no evidence that the strength of the association between socioeconomic position and mortality is different for Māori and non-Māori.
- Over time, there is a trend for the SRRs to increase among non-Māori, except for females aged 60–77 years. However, for Māori the interpretation of trends is limited by wide confidence intervals. The test for difference in trends in SRRs between Māori and non-Māori was not significant for any age or sex group, suggesting that the trend for Māori is likely to be similar to that for non-Māori.

[7] That is, the ratio of age standardised mortality rates for people with no qualifications to those with qualifications.

Table 4: SRR (95% CI), by education level

Sex	Age	Cohort	No qualifications: qualifications SRR (95% CI)		P value for difference in trend
			Māori	Non-Māori	
Males	25–77 years	1981–84	1.30 (1.05–1.61)	1.20 (1.16–1.25)	
		1986–89	1.43 (1.22–1.67)	1.24 (1.20–1.28)	
		1991–94	1.22 (1.07–1.39)	1.26 (1.22–1.30)	
		1996–99	1.30 (1.17–1.43)	1.27 (1.23–1.32)	
		P (trend)	0.636	0.047	0.354
	25–59 years	1981–84	1.56 (1.26–1.93)	1.31 (1.22–1.40)	
		1986–89	1.32 (1.12–1.56)	1.36 (1.27–1.45)	
		1991–94	1.46 (1.26–1.69)	1.39 (1.30–1.49)	
		1996–99	1.60 (1.40–1.82)	1.55 (1.44–1.66)	
		P (trend)	0.426	0.005	0.724
	60–77 years	1981–84	1.19 (0.88–1.60)	1.16 (1.11–1.22)	
		1986–89	1.49 (1.19–1.88)	1.20 (1.15–1.24)	
		1991–94	1.12 (0.94–1.33)	1.21 (1.17–1.26)	
		1996–99	1.18 (1.03–1.34)	1.18 (1.14–1.23)	
		P (trend)	0.393	0.650	0.354
Females	25–77 years	1981–84	1.16 (0.83–1.62)	1.22 (1.16–1.29)	
		1986–89	1.37 (1.07–1.74)	1.23 (1.18–1.29)	
		1991–94	1.50 (1.27–1.77)	1.32 (1.27–1.37)	
		1996–99	1.34 (1.17–1.53)	1.28 (1.23–1.34)	
		P (trend)	0.798	0.090	0.910
	25–59 years	1981–84	1.20 (0.94–1.52)	1.27 (1.17–1.38)	
		1986–89	1.57 (1.25–1.96)	1.30 (1.20–1.41)	
		1991–94	1.62 (1.35–1.93)	1.41 (1.30–1.52)	
		1996–99	1.27 (1.09–1.47)	1.47 (1.36–1.60)	
		P (trend)	0.868	0.016	0.263
	60–77 years	1981–84	1.14 (0.72–1.81)	1.21 (1.14–1.29)	
		1986–89	1.30 (0.95–1.79)	1.21 (1.15–1.28)	
		1991–94	1.46 (1.17–1.82)	1.29 (1.23–1.35)	
		1996–99	1.36 (1.15–1.62)	1.22 (1.16–1.28)	
		P (trend)	0.632	0.530	0.726

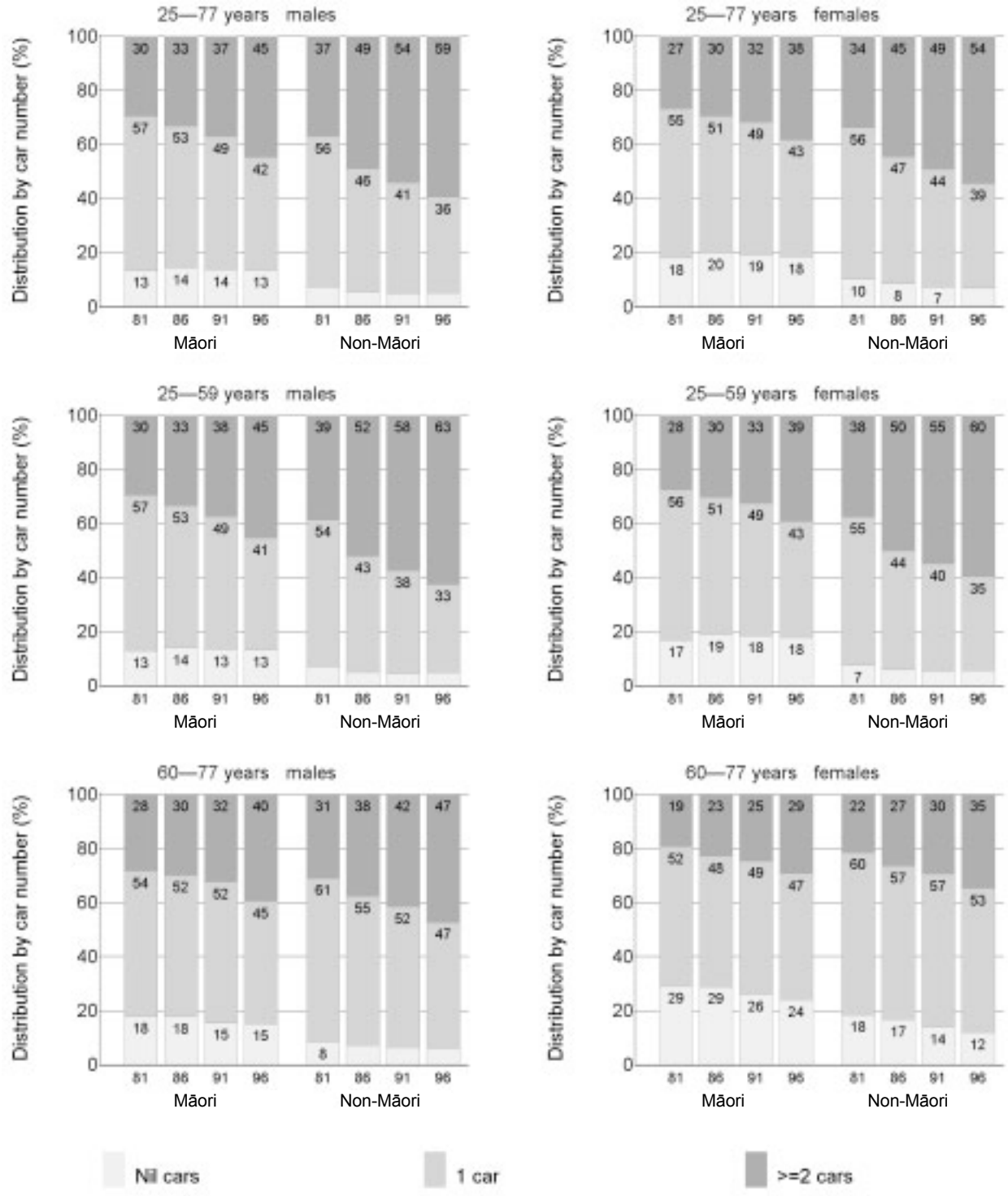
Household car access

Car access distribution

Figure 6 shows the distribution of the cohorts by car access. Household car access is interpreted in these results as an indicator of household wealth.

- For both Māori and non-Māori, the percentage of people with access to two or more cars increases over time. At the same time, there is a decrease in the proportion of households with access to one car. The proportion of households with no car changes very little.
- The proportion of people with access to two or more cars is less for Māori than for non-Māori in all cohorts. Conversely, the proportion of people in households with no car access is generally about twice as large for Māori than for non-Māori.

Figure 6: Distribution of population, by car access, ethnicity and cohort



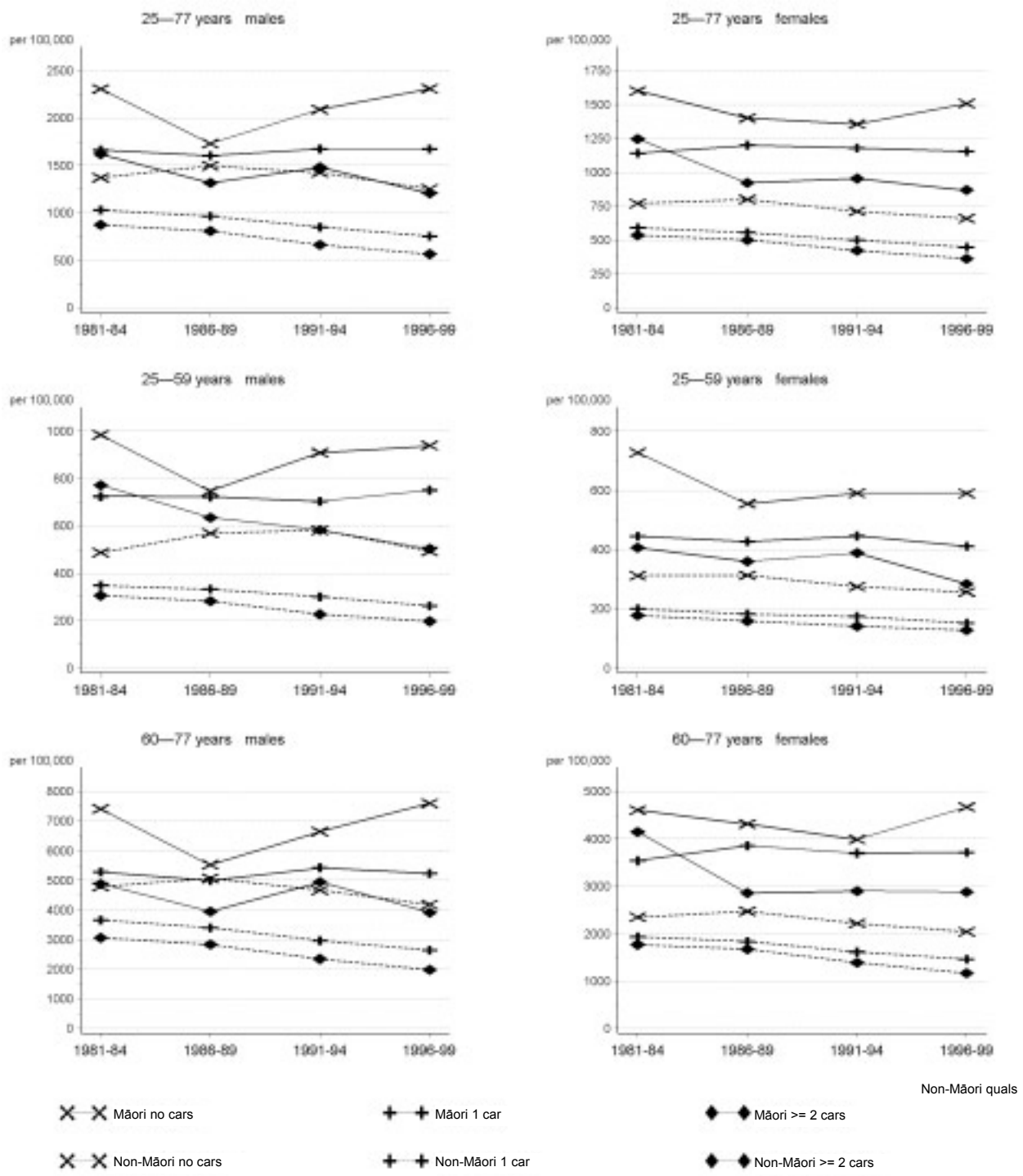
Note: The numbers in each block are the actual percentages.

Mortality rates, by household car access

Figure 7 shows all-cause mortality rates, by household car access (0, 1, 2 cars) for Māori and non-Māori, by age and sex.

- For both Māori and non-Māori, lack of access to a car is associated with higher mortality rates. There is also a gradient such that mortality decreases step-wise with increasing number of cars in the household.
- Within each level of car access, mortality rates are greater for Māori than for non-Māori. For females, the gap between Māori and non-Māori is least for those in households with two or more cars, but for males, there is no consistent pattern.
- Among females, mortality rates for Māori with access to two or more cars are higher than rates for non-Māori who lack access to a car.
- In general, the gap between Māori and non-Māori is greatest in the later two cohorts.

Figure 7: Mortality rates, by household car access



Note: actual mortality rates (and 95% confidence intervals) represented in this figure are shown in Table A6 in the Appendix.

Is the relationship between household access to cars and mortality different for Māori and non-Māori?

The SRRs for no access to cars relative to two or more cars[8] are given in Table 5.

- For males, the SRRs for non-Māori are greater than the SRRs for Māori in all time periods and age groups. For females, the pattern is different. The SRR for non-Māori is greater than for Māori for ages 25–77 years in all periods, but when broken down into 25–59 and 60–77 years age groups, the pattern is less consistent, and in all instances, the confidence intervals for Māori and non-Māori overlap. It should, however, be noted that the higher SRRs for non-Māori arise because the mortality rates of the reference group (two-plus cars) are very low, and the lower SRRs for Māori arise because the mortality rates of the reference group (two-plus cars) are comparatively higher.
- Over time, there is a trend for the SRRs to increase for all age, sex and ethnic groups. Although the test for trend does not reach statistical significance for non-Māori females aged 25–59 years or for Māori females aged 60–77 years, there is statistical evidence that overall these trends differ between Māori and non-Māori.

In summary, these results suggest that there is a difference between Māori and non-Māori in the strength of the association between household access to cars and mortality rates. The SRRs for non-Māori are higher as a consequence of very low mortality levels for respondents in households with two or more cars. However, both ethnic groups show a similar increase in inequality in mortality by car access over time.

[8] That is, the ratio of age-standardised mortality rates for people in households with no cars to those in households with two or more cars.

Table 5: SRR (95% CI), by car access

Sex	Age	Cohort	No cars: ≥ 2 cars SRR (95% CI)		P value for difference in trend
			Māori	Non-Māori	
Males	25–77 years	1981–84	1.43 (1.16–1.75)	1.57 (1.48–1.67)	
		1986–89*	1.31 (1.09–1.59)	1.85 (1.75–1.97)	
		1991–94*	1.41 (1.19–1.68)	2.15 (2.02–2.28)	
		1996–99	1.91 (1.67–2.19)	2.22 (2.08–2.36)	
		P (trend)	0.013	<0.001	0.776
	25–59 years	1981–84	1.28 (1.00–1.63)	1.59 (1.41–1.80)	
		1986–89*	1.18 (0.93–1.48)	2.02 (1.78–2.28)	
		1991–94*	1.56 (1.27–1.91)	2.56 (2.26–2.91)	
		1996–99	1.86 (1.55–2.23)	2.50 (2.21–2.82)	
		P (trend)	0.009	<0.001	0.699
	60–77 years	1981–84	1.52 (1.14–2.02)	1.56 (1.45–1.68)	
		1986–89	1.40 (1.07–1.84)	1.79 (1.67–1.91)	
		1991–94*	1.34 (1.06–1.70)	1.99 (1.86–2.13)	
		1996–99	1.94 (1.62–2.33)	2.11 (1.97–2.27)	
		P (trend)	0.132	<0.001	0.913
Females	25–77 years	1981–84	1.28 (0.92–1.79)	1.44 (1.33–1.55)	
		1986–89	1.52 (1.19–1.94)	1.60 (1.49–1.72)	
		1991–94	1.42 (1.16–1.74)	1.68 (1.57–1.81)	
		1996–99	1.74 (1.45–2.08)	1.82 (1.70–1.96)	
		P (trend)	0.202	<0.001	0.842
	25–59 years	1981–84	1.79 (1.37–2.35)	1.76 (1.52–2.03)	
		1986–89	1.54 (1.20–1.97)	1.97 (1.70–2.27)	
		1991–94	1.52 (1.22–1.89)	1.94 (1.66–2.27)	
		1996–99	2.07 (1.69–2.54)	2.01 (1.75–2.32)	
		P (trend)	0.370	0.342	0.773
	60–77 years	1981–84	1.11 (0.71–1.73)	1.33 (1.21–1.45)	
		1986–89	1.51 (1.08–2.11)	1.48 (1.36–1.60)	
		1991–94	1.37 (1.04–1.82)	1.59 (1.47–1.72)	
		1996–99	1.62 (1.28–2.06)	1.75 (1.61–1.90)	
		P (trend)	0.294	<0.001	0.945

* Non-overlapping confidence intervals for Māori and non-Māori.

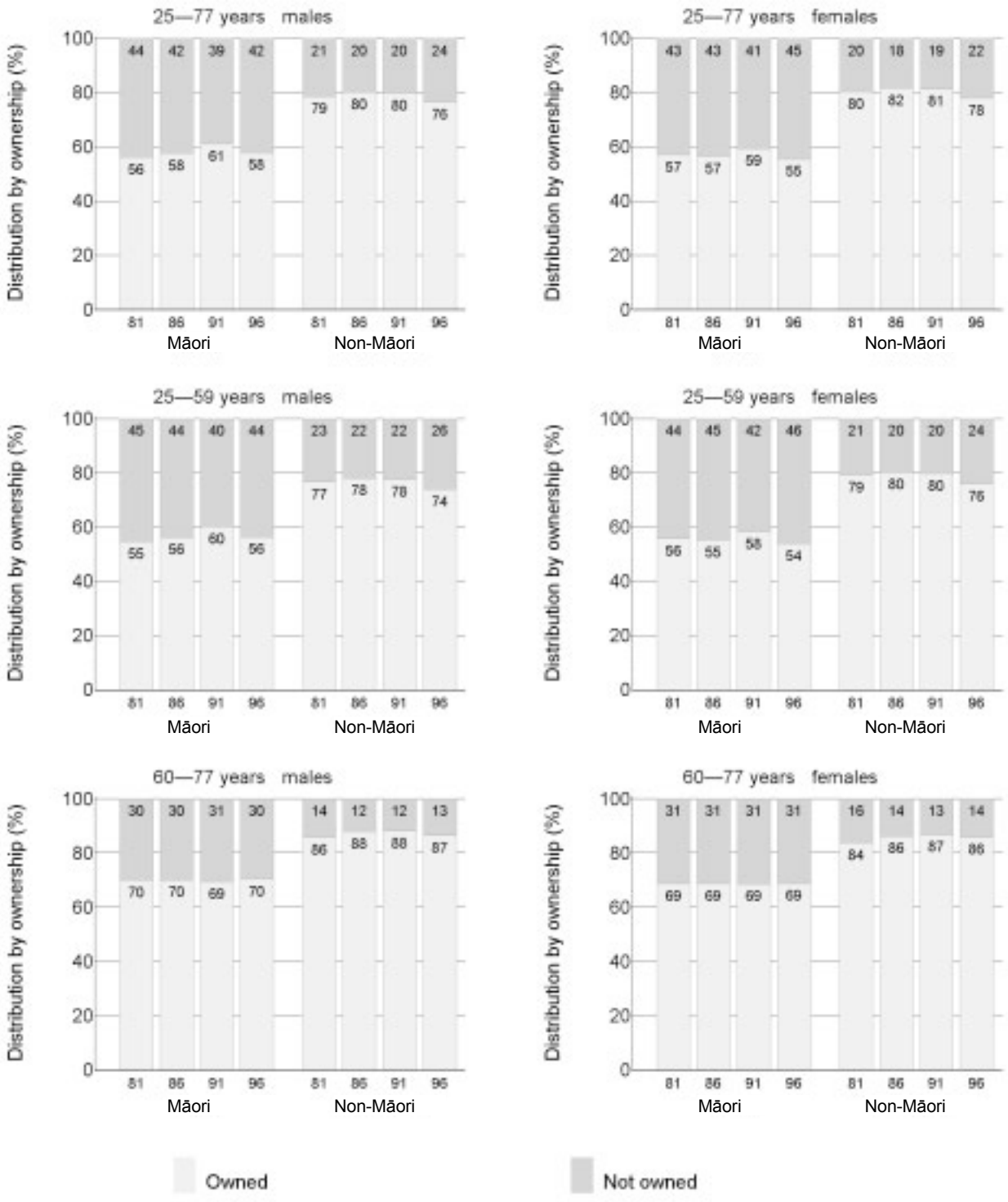
Housing tenure

Tenure distribution

Figure 8 shows the distribution of the cohorts, by housing tenure (again, primarily a proxy indicator of household wealth).

- The proportion of Māori who do not live in owner-occupied houses is approximately twice that of non-Māori.
- The proportion of people in owner-occupied houses is greatest in the 60–77 years age group, for both ethnic groups.
- There has been little change in the proportion of adults owning their home over the observation period (for all age-by-sex-by ethnicity groups).

Figure 8: Distribution of population, by household tenure, ethnicity and cohort



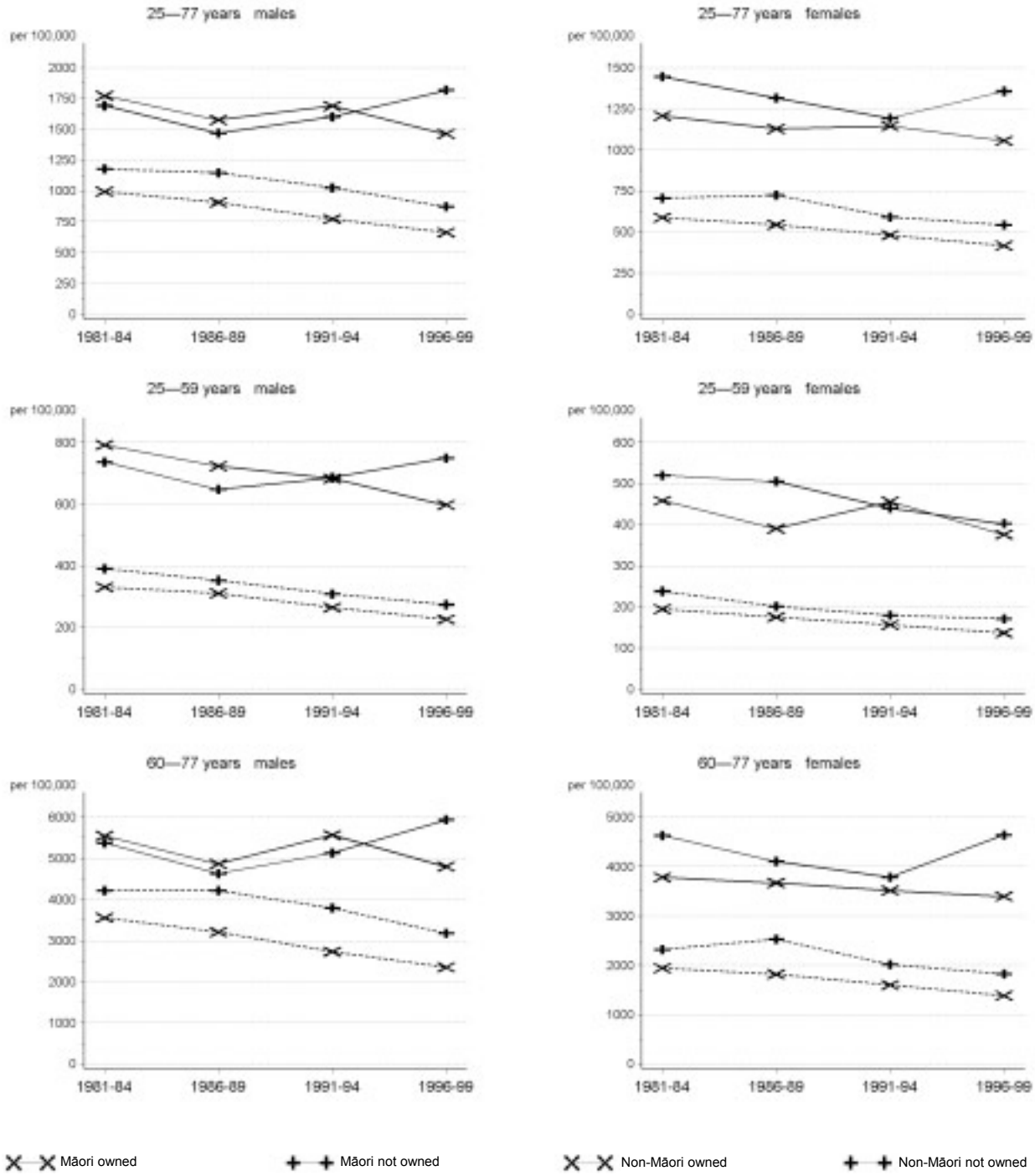
Note: The numbers in each block are the actual percentages.

Mortality rates, by tenure

Figure 9 shows all-cause age-standardised mortality rates, by housing tenure (owned, not owned) for Māori and non-Māori, by age and sex.

- Mortality rates were higher for Māori than non-Māori in both categories of household tenure.
- However, the pattern of mortality by household tenure was different for Māori and non-Māori. For non-Māori, mortality rates were higher for people who did not live in a house owned by a member of the household. This is particularly the case for cohort members aged 60–77 years. Both tenure groups, however, show substantial declines in mortality over time.
- By contrast, for Māori, living in an owner-occupied house is not consistently associated with lower mortality rates (except among 60–77-year-old females).

Figure 9: Mortality rates, by household tenure



Note: actual mortality rates (and 95% confidence intervals) represented in this figure are shown in Table A7 in the Appendix.

Is the association of household tenure with mortality different for Māori and non-Māori?

Table 6 shows the SRRs for people who did not live in owner-occupied houses compared to those that did,[9] by ethnicity and cohort.

- Living in an owner-occupied house was consistently associated with a mortality advantage for non-Māori. However, this was not the case for Māori males, for whom a mortality advantage for those living in an owner-occupied house only became evident in 1996–99.
- When SRRs for Māori males are compared with SRRs for non-Māori males, the confidence intervals did not overlap for five of eight comparisons for the first three cohorts. By 1996–99, SRRs for Māori males were of a similar order to those for non-Māori males. These results suggest that the association between household tenure and mortality became more similar over time, for Māori and non-Māori males.
- Both Māori and non-Māori females show a general pattern of excess mortality among people who do not live in owner-occupied houses. However, for Māori, the confidence intervals of the SRR include 1.0 in most instances. Furthermore, the SRRs for Māori and non-Māori overlap in all age groups and periods.
- There is some evidence that the association between tenure and mortality increased over time for males aged 25–77 years. The confidence intervals for the first and last cohorts do not overlap. This pattern is seen for both Māori and non-Māori.

In summary, there is tentative evidence that for males the association between household tenure was weaker for Māori than non-Māori in the earlier cohorts, due to a lack of association between household tenure and mortality for Māori. However, by the most recent cohort, the SRRs for Māori and non-Māori are of similar magnitude.

[9] That is, the ratio of age-standardised mortality rates for people who do not live in owner-occupied housing compared to those who do.

Table 6: SRR (95% CI), by household tenure

Sex	Age	Cohort	Not owned : owned SRR (95% CI)		P value for difference in trend
			Māori	Non-Māori	
Males	25–77 years	1981–84*	0.96 (0.82–1.11)	1.18 (1.13–1.24)	
		1986–89*	0.93 (0.81–1.07)	1.27 (1.21–1.32)	
		1991–94*	0.95 (0.84–1.07)	1.33 (1.27–1.39)	
		1996–99	1.24 (1.12–1.38)	1.31 (1.26–1.37)	
		P (trend)	0.769	0.896	0.889
	25–59 years	1981–84*	0.93 (0.79–1.09)	1.18 (1.09–1.27)	
		1986–89*	0.90 (0.77–1.05)	1.14 (1.05–1.23)	
		1991–94	1.00 (0.87–1.16)	1.17 (1.07–1.28)	
		1996–99	1.25 (1.10–1.43)	1.21 (1.11–1.32)	
		P (trend)	0.717	0.971	0.804
	60–77 years	1981–84	0.97 (0.79–1.19)	1.19 (1.13–1.25)	
		1986–89*	0.95 (0.78–1.16)	1.31 (1.25–1.38)	
		1991–94	0.92 (0.78–1.09)	1.39 (1.32–1.46)	
		1996–99	1.24 (1.08–1.42)	1.35 (1.28–1.43)	
		P (trend)	0.801	0.875	0.922
Females	25–77 years	1981–84	1.20 (1.01–1.43)	1.20 (1.14–1.27)	
		1986–89	1.17 (0.99–1.37)	1.33 (1.26–1.40)	
		1991–94	1.04 (0.90–1.21)	1.23 (1.16–1.30)	
		1996–99	1.29 (1.13–1.46)	1.30 (1.23–1.38)	
		P (trend)	0.974	0.953	0.989
	25–59 years	1981–84	1.14 (0.94–1.37)	1.22 (1.11–1.35)	
		1986–89	1.29 (1.08–1.55)	1.15 (1.03–1.28)	
		1991–94	0.96 (0.82–1.14)	1.15 (1.03–1.28)	
		1996–99	1.07 (0.92–1.25)	1.25 (1.14–1.38)	
		P (trend)	0.870	0.980	0.891
	60–77 years	1981–84	1.22 (0.97–1.55)	1.19 (1.13–1.27)	
		1986–89	1.12 (0.90–1.39)	1.39 (1.31–1.48)	
		1991–94	1.08 (0.88–1.32)	1.26 (1.18–1.34)	
		1996–99	1.37 (1.16–1.61)	1.32 (1.24–1.41)	
		P (trend)	0.921	0.938	0.979

* Confidence intervals for Māori and non-Māori do not overlap.

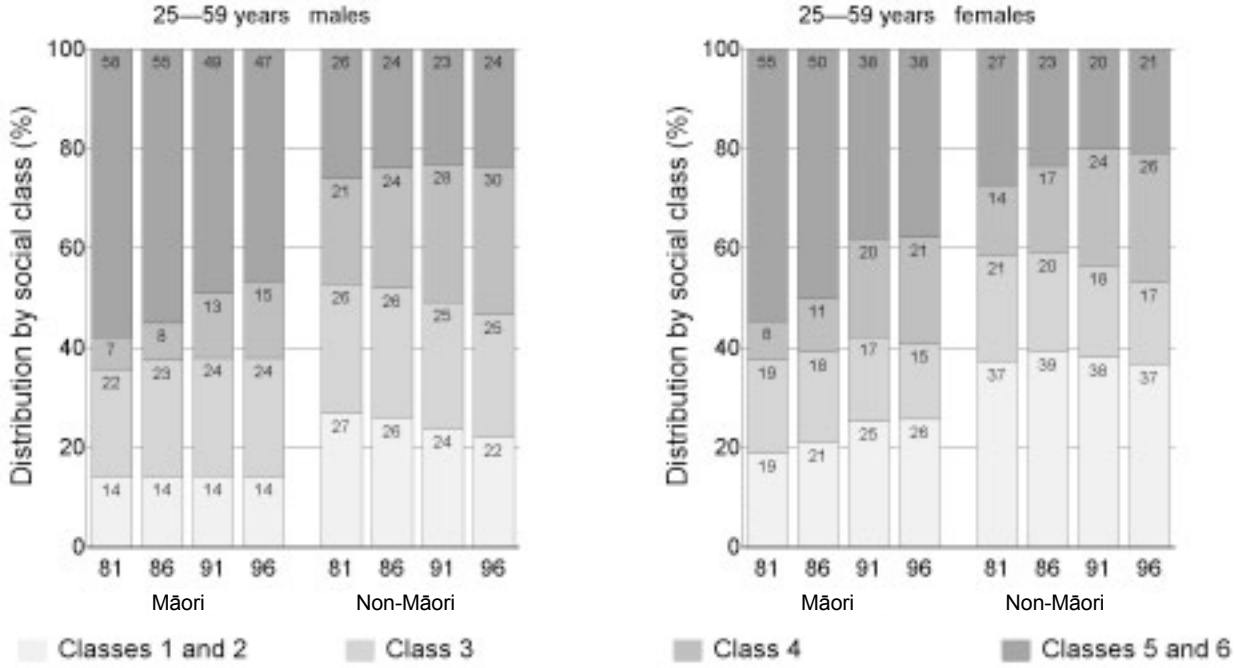
Occupational social class

Occupational class distribution

Figure 10 shows the distribution of each cohort across the Elley–Irving occupational classes (classes 1 and 2 combined, class 3, class 4, classes 5 and 6 combined) for Māori and non-Māori, by sex. These analyses were limited to ages 25–59 years because large proportions of the older population were not in the labour force and so had no current occupation from which to code the social class variable.

Compared to non-Māori, Māori are distributed more towards the lower social classes (classes 5 and 6). For both Māori and non-Māori, there is a trend over time for greater numbers of people to be in higher social classes (classes 1 and 2). Corresponding decreases in the size of other classes occurred over time, although the size of the combined classes 5 and 6 remained fairly stable for non-Māori males.

Figure 10: Distribution of the population, by occupational class, ethnicity and cohort

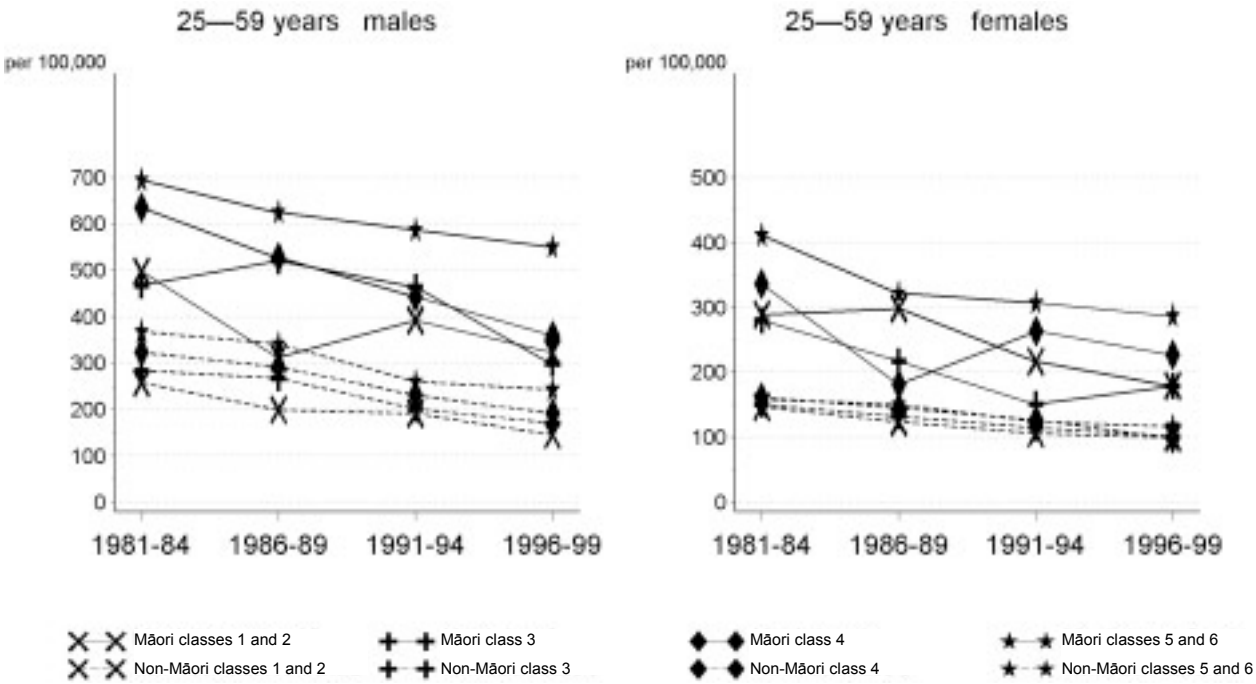


Mortality rates, by occupational social class

Figure 11 shows all-cause mortality rates for each cohort by occupational social class (Elley–Irving classes 1 and 2, 3, 4, 5 and 6) for Māori and non-Māori, by age and sex. Caution is required in interpreting these results, however, because of a high rate of missing occupational data for all subgroups. Furthermore, the amount of missing data for Māori was almost twice that for non-Māori (see Appendix, Table A1).

- Within each occupational class, mortality rates are lower for non-Māori than for Māori.
- Within each ethnic group, mortality rates are lower for higher social classes. However, the disadvantage associated with low social class is greater for Māori than for non-Māori (both sexes).
- All social classes show a decline in mortality rates over time. This is true for both Māori and non-Māori. With all the other socioeconomic position indicators employed in this report, no improvement in mortality is found for Māori in low socioeconomic positions. A possible explanation is that occupational social class can be identified only for labour force participants (ie, people with a current occupation). The lack of improvement in mortality rates over time among Māori occupying low socioeconomic positions may therefore be driven largely by non-labour force participants.

Figure 11: Mortality rates, by Elley–Irving occupational class (ages 25–59 years only)



Note: actual mortality rates (and 95% confidence intervals) represented in this figure are shown in Table A8 in the Appendix.

Labour force status

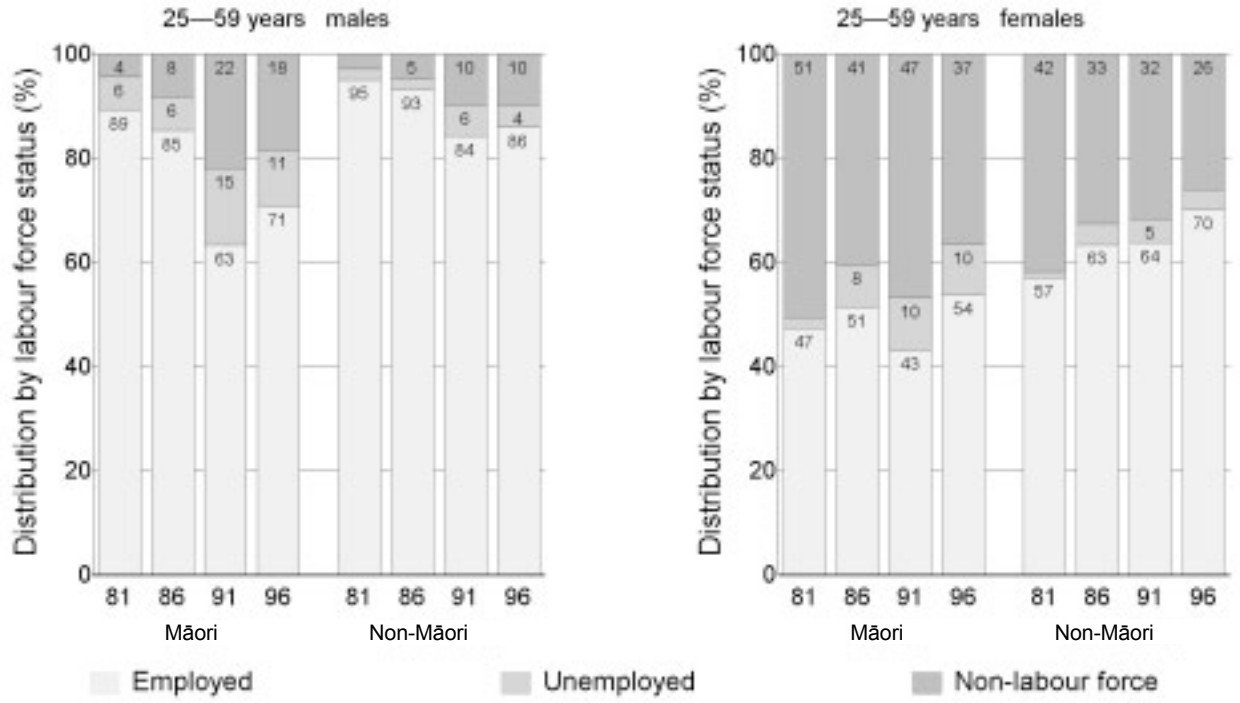
Labour force participants are classified as either employed or unemployed. Non-labour force participants are a diverse and changing group, with higher mortality rates overall than those in the labour force.

Labour force status distribution

Figure 12 shows the distribution of the population by labour force status across cohorts for Māori and non-Māori, by age and sex.

- The proportion employed was much higher for non-Māori than for Māori.
- Both the proportion unemployed and the proportion not in the labour force were higher for females than for males.
- Employment rates were lowest in 1991–94 for all sex-by-ethnicity groups, except non-Māori females, for whom employment rates were lowest in 1981–84.

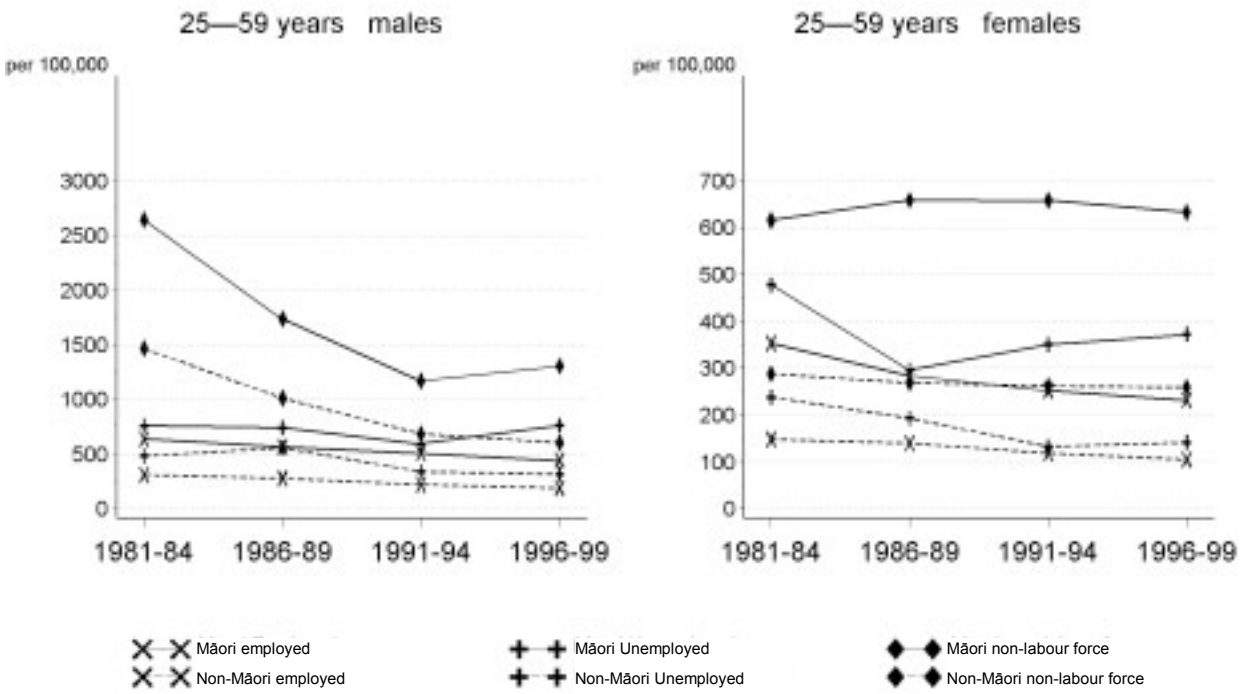
Figure 12: Distribution of population, by labour force status, ethnicity and cohort



Mortality rates, by labour force status

Figure 13 shows mortality rates, by labour force status, for Māori and non-Māori, by age and sex.

Figure 13: Mortality rates, by labour force status (ages 25–59 only)



Note: actual mortality rates (and 95% confidence intervals) represented in this figure are shown in Table A8 in the Appendix.

- Within each labour force category, Māori have higher mortality than non-Māori.
- For both ethnic groups, mortality rates are highest for non-participants. Trends in this group differ by gender over the observation period. Among males, mortality declined steeply (both ethnic groups), whereas for females, mortality declined only slightly for non-Māori and not at all for Māori.
- For labour force participants, mortality rates are higher among the unemployed than among the employed (all subgroups). Among non-Māori (both sexes), mortality declined substantially for both the employed and unemployed over the study period. Among Māori, however, mortality fell only among the employed, remaining essentially stable among the unemployed.

Socioeconomic Mediation of Ethnic Inequalities

This chapter addresses the remaining research questions (Box 3). These analyses are limited to respondents with non-missing values for all socioeconomic variables. Pacific people were also excluded because small numbers in some strata limited the possible multivariate models. Unlike previous chapters, the comparison here is therefore between the Māori and non-Māori non-Pacific ethnic groups.

Box 3: Research questions addressed in this chapter

Question 5: What proportion of the inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was mediated by socioeconomic inequality, on average, over the study period?

Question 6: How much of the *increase* in inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was attributable to increasing socioeconomic inequality over the study period?

Average contribution of socioeconomic pathways

Table 7 shows the all-cause mortality rate ratio (RR) for Māori compared to non-Māori non-Pacific ethnic groups, by cohort, estimated from models in which the RR is adjusted for age and region only (model A) and models in which the RR is adjusted for age, region, income, education, household tenure and car access (model B).

Region (RHA) is adjusted for as a confounder (see Methods, page 6). Model B further adjusts for a subset of socioeconomic factors that might mediate some of the association of ethnicity with mortality risk. However, model B does not include those socioeconomic factors that are available only for some cohorts (eg, NZDep) or for some age groups (eg, labour force status and occupational class).

For each cohort, the RRs estimated from model B are lower than those estimated from model A, but the reduction is only partial. More specifically, the four socioeconomic factors included in model B appear to account for about 25% of the ethnic disparity in mortality (the range is from 18% to 37%, depending on subgroup). The contribution is roughly similar for all age groups and both genders.

Table 7: RR for Māori compared to non-Māori non-Pacific – results of regression analyses

Age	Sex	Model	1981–84	1986–89	1991–94	1996–99
25–77 years	Males	A	2.01 (1.86–2.17)	1.90 (1.77–2.04)	2.30 (2.17–2.44)	2.42 (2.29–2.56)
		B	1.76 (1.63–1.91)	1.63 (1.52–1.75)	1.88 (1.77–2.01)	2.03 (1.92–2.15)
		% reduction RR, A to B*	25%	30%	32%	27%
	Females	A	2.32 (2.11–2.54)	2.30 (2.12–2.49)	2.59 (2.41–2.77)	2.72 (2.54–2.90)
		B	2.05 (1.87–2.26)	1.99 (1.83–2.17)	2.19 (2.04–2.35)	2.33 (2.18–2.49)
		% reduction RR A to B	20%	24%	25%	23%
25–59 years	Males	A	2.43 (2.20–2.69)	2.23 (2.04–2.45)	2.59 (2.38–2.81)	2.72 (2.52–2.95)
		B	2.06 (1.86–2.29)	1.91 (1.74–2.11)	2.04 (1.87–2.23)	2.18 (2.01–2.38)
		% reduction RR A to B	26%	26%	35%	31%
	Females	A	2.37 (2.09–2.68)	2.37 (2.12–2.66)	2.82 (2.56–3.10)	2.81 (2.56–3.09)
		B	2.02 (1.77–2.30)	1.99 (1.77–2.24)	2.27 (2.05–2.52)	2.31 (2.09–2.55)
		% reduction RR A to B	26%	28%	30%	28%
60–77 years	Males	A	1.61 (1.43–1.80)	1.59 (1.44–1.76)	2.09 (1.92–2.27)	2.16 (2.01–2.33)
		B	1.44 (1.28–1.62)	1.37 (1.23–1.51)	1.73 (1.59–1.89)	1.85 (1.71–2.00)
		% reduction RR A to B	28%	37%	33%	27%
	Females	A	2.19 (1.92–2.50)	2.22 (1.99–2.48)	2.39 (2.17–2.63)	2.65 (2.43–2.89)
		B	1.98 (1.73–2.26)	1.96 (1.75–2.19)	2.06 (1.87–2.27)	2.33 (2.13–2.55)
		% reduction RR A to B	18%	21%	24%	19%

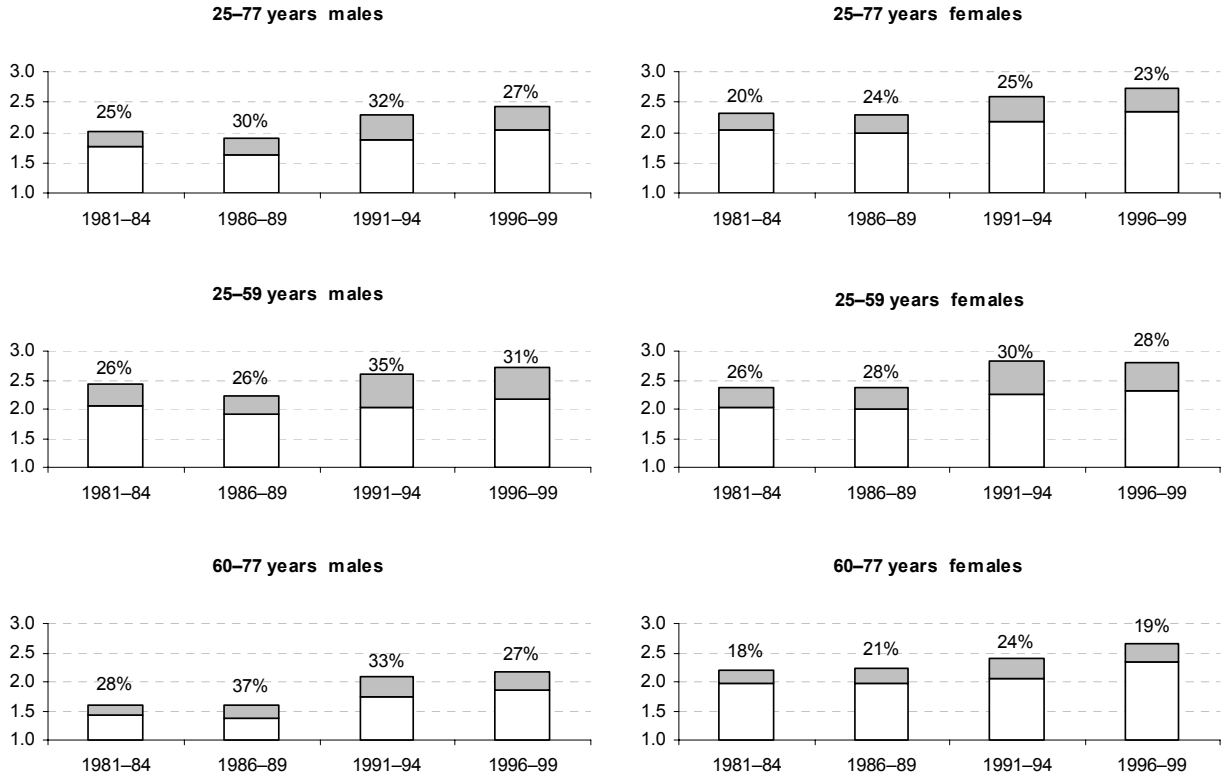
Notes: Model A = age, RHA; Model B = age, RHA, education, income, car, tenure.

* The excess rate ratio is [RR –1].

Trends in the socioeconomic contribution

Figure 14 summarises trends in the RR for Māori compared to non-Māori non-Pacific ethnic groups. For the 25–59 years age group, inclusion of socioeconomic variables in the model substantially reduces the trend for the RR to increase over time. For the 60–77 years age group, the RR continues to increase over time even when all four socioeconomic variables are included in the model.

Figure 14: All-cause mortality RR for Māori compared to non-Māori non-Pacific ethnic groups, estimated from models including and excluding socioeconomic position



Note: The full height of each bar shows the RR for the model, including age and RHA only (model A). The non-shaded area is the RR for the model including income, education, car access and housing tenure (model B). The percentages refer to the percentage reduction in the excess hazard (ie, RR–1) for model B compared to model A.

Inclusion of additional socioeconomic variables

For the working-age population, additional labour market variables are available to further delineate socioeconomic position. Tables 8 and 9 show the RR for Māori compared to non-Māori non-Pacific ethnic groups for models with the additional variables 'social class', 'labour force status' and 'position in the labour market' added to Model B (see Methods chapter for a definition of these variables). Note that a substantial proportion of each cohort had missing values for the social class variable; this should be considered when interpreting the results. Also, only people who are currently employed are assigned a social class. The variation in socioeconomic position within the latter group is consequently less than for the total population.

Adding each variable to the model in turn resulted in an additional reduction in the RR of mortality for Māori compared to non-Māori non-Pacific peoples. With all three additional variables included in the model, socioeconomic factors collectively account for 21–46% of the ethnic disparity in mortality (depending on the age–sex subgroup).

Also of interest is that labour force status becomes important as a contributor to ethnic inequalities in mortality only in the 1990s. The greatest effect is seen in 1991–94, for males only, when unemployment reached its highest level in decades and Māori were particularly adversely affected. Thus there is evidence from our model that labour force status was an important driver of the increased RR for Māori in the 1990s.

Table 8: RR for Māori males compared to non-Māori males, results of regression analyses including labour market variables, ages 25–59 years

Subset	Model	1981–84	1986–89	1991–94	1996–99
I (social class)	A	2.18 (1.92–2.48)	2.15 (1.91–2.42)	2.36 (2.08–2.68)	2.28 (2.02–2.57)
	B	2.01 (1.76–2.30)	1.93 (1.71–2.19)	2.11 (1.85–2.41)	2.01 (1.77–2.28)
	% reduction RR A to B	14%	19%	18%	21%
	C	1.94 (1.70–2.23)	1.85 (1.63–2.10)	2.07 (1.81–2.36)	1.94 (1.71–2.21)
	% reduction RR B to C	7%	9%	4%	7%
	% reduction RR A to C	20%	26%	21%	27%
II (LFS)	A	2.43 (2.18–2.71)	2.21 (2.00–2.44)	2.53 (2.32–2.76)	2.74 (2.52–2.98)
	B	2.03 (1.81–2.27)	1.83 (1.65–2.03)	1.97 (1.80–2.16)	2.17 (1.99–2.38)
	% reduction RR A to B	28%	31%	37%	33%
	D	2.03 (1.81–2.27)	1.82 (1.64–2.02)	1.83 (1.67–2.00)	2.08 (1.90–2.27)
	% reduction RR B to D	0%	1%	14%	8%
	% reduction RR A to D	28%	32%	46%	38%
III (PLM)	A	2.43 (2.18–2.71)	2.21 (2.00–2.44)	2.53 (2.32–2.76)	2.74 (2.52–2.98)
	B	2.03 (1.81–2.27)	1.83 (1.65–2.03)	1.97 (1.80–2.16)	2.17 (1.99–2.38)
	% reduction RR A to B	28%	31%	37%	33%
	E	2.02 (1.80–2.26)	1.78 (1.61–1.98)	1.82 (1.66–1.99)	2.06 (1.89–2.25)
	% reduction RR B to E	1%	6%	15%	9%
	% reduction RR A to E	29%	36%	46%	39%

Notes: Subset I = restricted to those with non-missing social class; Subset II = restricted to those with non-missing labour force status (LFS); Subset III = restricted to those with non-missing position in the labour market (PLM). Model A = age, RHA; Model B = age, RHA, education, income, car, tenure; Model C = age, RHA, education, income, car, tenure, social class; Model D = age, RHA, education, income, car, tenure, labour force status (LFS); Model E = age, RHA, education, income, car, tenure, position in labour force (PLM).

Table 9: RR for Māori females compared to non-Māori females, results of regression analyses including labour market variables, ages 25–59 years

Subset	Model	1981–84	1986–89	1991–94	1996–99
I (social class)	A	2.26 (1.80–2.84)	1.84 (1.50–2.27)	2.38 (1.95–2.90)	2.48 (2.09–2.96)
	B	2.26 (1.79–2.86)	1.72 (1.38–2.13)	2.15 (1.75–2.64)	2.30 (1.92–2.76)
	% excess RR A to B	0%	14%	17%	12%
	C	2.25 (1.78–2.85)	1.70 (1.37–2.11)	2.17 (1.76–2.66)	2.26 (1.89–2.72)
	% excess RR B to C	1%	3%	–2%	3%
	% excess RR A to C	1%	17%	15%	15%
II (LFS)	A	2.28 (2.00–2.60)	2.30 (2.04–2.59)	2.77 (2.51–3.07)	2.79 (2.52–3.08)
	B	1.97 (1.72–2.25)	1.96 (1.73–2.22)	2.25 (2.02–2.51)	2.31 (2.08–2.57)
	% excess RR A to B	24%	26%	29%	27%
	D	2.01 (1.75–2.30)	2.02 (1.78–2.29)	2.25 (2.02–2.51)	2.34 (2.11–2.60)
	% excess RR B to D	-4%	–6%	0%	–2%
	% excess RR A to D	21%	22%	29%	25%
III (PLM)	A	2.28 (2.00–2.60)	2.30 (2.04–2.59)	2.77 (2.51–3.07)	2.79 (2.52–3.08)
	B	1.97 (1.72–2.25)	1.96 (1.73–2.22)	2.25 (2.02–2.51)	2.31 (2.08–2.57)
	% excess RR A to B	24%	26%	29%	27%
	E	2.01 (1.75–2.30)	2.02 (1.78–2.29)	2.25 (2.02–2.51)	2.34 (2.10–2.60)
	% excess RR B to E	-4%	–6%	0%	–2%
	% excess RR A to E	21%	22%	29%	25%

Notes: Subset I = restricted to those with non-missing social class; Subset II = A restricted to those with non-missing labour force status (LFS); Subset III = A restricted to those with non-missing position in the labour market (PLM).

Model A = age, RHA; Model B = age, RHA, education, income, car, tenure; Model C = age, RHA, education, income, car, tenure, social class; Model D = age, RHA, education, income, car, tenure, labour force status (LFS); Model E = age, RHA, education, income, car, tenure, position in labour force (PLM).

Does small-area deprivation make an independent contribution to ethnic inequalities in mortality?

Census-based small-area indexes of deprivation (NZDep91 and NZDep96) are available for the 1991–94 and 1996–99 cohorts. Table 10 compares the all-cause mortality RR with and without adjusting for NZDep in addition to the four socioeconomic variables discussed above.

Addition of NZDep further reduces the RR compared to the model including only the four main socioeconomic variables – income, education, car access and household tenure (model B). This suggests that the contribution of socioeconomic position to ethnic mortality inequality is in fact greater than that captured by the four main socioeconomic factors alone. However, as no area deprivation measure is available for the first two cohorts, it is not possible to assess whether the mediating effect of area-level deprivation increased or decreased across the four cohorts.

Table 10: Comparison of RR for Māori compared to non-Māori ethnic groups for models, excluding and including the NZDep variable, all-cause mortality, ages 25–77 years

Sex	Model*	1991–94		1996–99	
Males	A	2.30	(2.17–2.44)	2.42	(2.29–2.56)
	B	1.88	(1.77–2.01)	2.03	(1.92–2.15)
	Reduction in RR A to B	32%		27%	
	B + NZ Dep	1.74	(1.63–1.85)	1.88	(1.77–1.99)
	Reduction in RR A to [B+NZDep]	43%		38%	
Females	A	2.59	(2.41– 2.77)	2.72	(2.54– 2.90)
	B	2.19	(2.04– 2.35)	2.33	(2.18– 2.49)
	Reduction in RR A to B	25%		23%	
	B + NZ Dep	2.03	(1.88–2.18)	2.14	(1.99–2.29)
	Reduction in RR A to [B+NZDep]	35%		34%	

* A = RHA and ethnicity, B = RHA, ethnicity, income, education, tenure, and car access.

Further models were run to investigate whether small-area deprivation was still significant if the position in the labour market variable (PLM) was also included in the regression model. Of necessity, these analyses were restricted to the subset of data with non-missing PLM values (Table 11). Even when all five measures of socioeconomic position are incorporated in the regression models, deprivation still produces a substantial additional reduction in the residual RR. With all socioeconomic variables included, the overall summary contribution of socioeconomic position to ethnic inequalities in mortality is approximately 50% (slightly more in males, slightly less in females). The incremental contribution of deprivation over and above the other socioeconomic variables is about the same in 1991–94 and in 1996–99.

Table 11: Comparison of RR for Māori compared to non-Māori ethnic groups for models, excluding and including the NZDep and PLM variables, all-cause mortality, ages 25–59 years

Sex	Model	1991–94		1996–99	
Males	A	2.53	(2.32–2.76)	2.74	(2.52–2.98)
	B	1.97	(1.80–2.16)	2.17	(1.99–2.38)
	B + PLM	1.82	(1.66–1.99)	2.06	(1.89–2.25)
	Reduction in RR A to [B+PLM]	46%		39%	
	B + NZ Dep	1.83	(1.68–2.00)	1.97	(1.81–2.15)
	B+PLM+NZDep	1.69	(1.54–1.85)	1.87	(1.72–2.04)
	Reduction in RR A to [B+PLM+NZDep]	55%		50%	
Females	A	2.77	(2.51–3.07)	2.79	(2.52–3.08)
	B	2.25	(2.02–2.51)	2.31	(2.08–2.57)
	B + PLM	2.25	(2.02–2.51)	2.34	(2.10–2.60)
	Reduction in RR A to [B+PLM]	29%		25%	
	B + NZ Dep	2.07	(1.86–2.31)	2.06	(1.86–2.29)
	B+PLM+NZDep	2.02	(1.81–2.25)	2.05	(1.84–2.27)
	Reduction in RR A to [B+PLM+NZDep]	43%		41%	

Notes: Model A = age, RHA; Model B = age, RHA, education, income, car, tenure.

Restricted to subset with no missing education, income, car, tenure, position in labour market variables.

How much of the trend in ethnic mortality inequality was due to socioeconomic factors?

This question was investigated by pooling the four cohorts and then running models A and B with time period added as a covariate; the models also include an interaction term for time period and ethnicity (Table 12). Note that these models assume that the trend in the RR is linear.

The output shown in Table 12 is the relative increase in all-cause mortality RR for Māori compared to the non-Māori non-Pacific ethnic group over each five-year period.[10] The measure of interest is how much this value decreases going from model A to model B.

- For males, the decrease is small (from 1.083 in model A to 1.081 in model B), suggesting that very little (2.4%) of the increase in the Māori to non-Māori non-Pacific RR over time was explained by increasing socioeconomic inequalities between these ethnic groups. Put another way, increasing socioeconomic disparities do not appear to be a major driver of the widening ethnic disparities in mortality for males – at least when income, education, car access and housing tenure are used (collectively) to index socioeconomic position.

[10] For example, assume that the Māori to non-Māori RR was 2.0 for 1981–84 for males aged 25–77 years according to model A. The increase in this RR for each subsequent period is given as 1.083 in Table 12. This would mean that the (modelled) Māori to non-Māori ratio was 2.17 (ie, 2.0 × 1.083) in 1986–89; 2.35 (ie, 2.17 × 1.083) in 1991–94; and 2.54 (ie, 2.35 × 1.083) in 1996–99.

- For females, the results are similar. The increase in the Māori to non-Māori non-Pacific RR from one period to the next averaged 1.060 according to model A and 1.056 according to model B. The reduction from Model A to B was only 6.7%.
- When age was taken into account, a greater proportion of the increasing trend in the Māori to non-Māori non-Pacific RR was mediated through socioeconomic factors for ages 25–59 years compared to ages 60–77 years. Nevertheless, even among 25–59-year-olds, the contribution of increasing socioeconomic inequality to the increase in ethnic inequality over time was only about 6% for males and 9% for females.

Importantly, though, once position in the labour market was included in the models for the 25–59 years age group, the reduction in the increase in the Māori to non-Māori non-Pacific RR over time going from model A to model B jumps to 59% for males and 32% for females. That is, for 25–59-year-olds at least, approximately half (males) or a third (females) of the widening gap in mortality rates between Māori and non-Māori non-Pacific ethnic groups during the 1980s and 1990s does appear to be attributable to widening socioeconomic inequalities, in particular increasing disparities in labour market position.

Table 12: Increase in the Māori to non-Māori non-Pacific RR over time

Age	Sex	Model	Increase in the Māori:non-Māori RR over five years*		Additionally adjusting for PLM (25–59 only) (subset with PLM)	
25–77 years	Males	A	1.083	(1.052–1.114)		
		B	1.081	(1.051–1.112)		
		% reduction RR A to B	2.4%			
	Females	A	1.060	(1.026–1.096)		
		B	1.056	(1.022–1.092)		
		% reduction RR A to B	6.7%			
25–59 years	Males	A	1.070	(1.029–1.112)	1.075	(1.033–1.118)
		B	1.066	(1.026–1.108)	1.031	(0.991–1.073)
		% reduction RR A to B	5.7%		59%	
	Females	A	1.068	(1.019–1.119)	1.069	(1.020–1.120)
		B	1.062	(1.013–1.112)	1.047	(0.999–1.098)
		% reduction RR A to B	8.8%		32%	
60–77 years	Males	A	1.115	(1.071–1.161)		
		B	1.116	(1.071–1.162)		
		% reduction RR A to B	-0.9%			
	Females	A	1.070	(1.021–1.120)		
		B	1.068	(1.019–1.119)		
		% reduction RR A to B	2.9%			

* The ratio is the average ratio of the RR for Māori compared to non-Māori non-Pacific in one period compared to the period five years earlier.

Does the contribution of socioeconomic position to the ethnic mortality disparity vary by cause of death?

The analysis outlined above for all-cause mortality was repeated for six broad causes of death groupings: cardiovascular disease, ischaemic heart disease, all cancer, lung cancer, non-lung cancer and injury (Figure 15). Statistical power was insufficient to examine more specific causes of death.

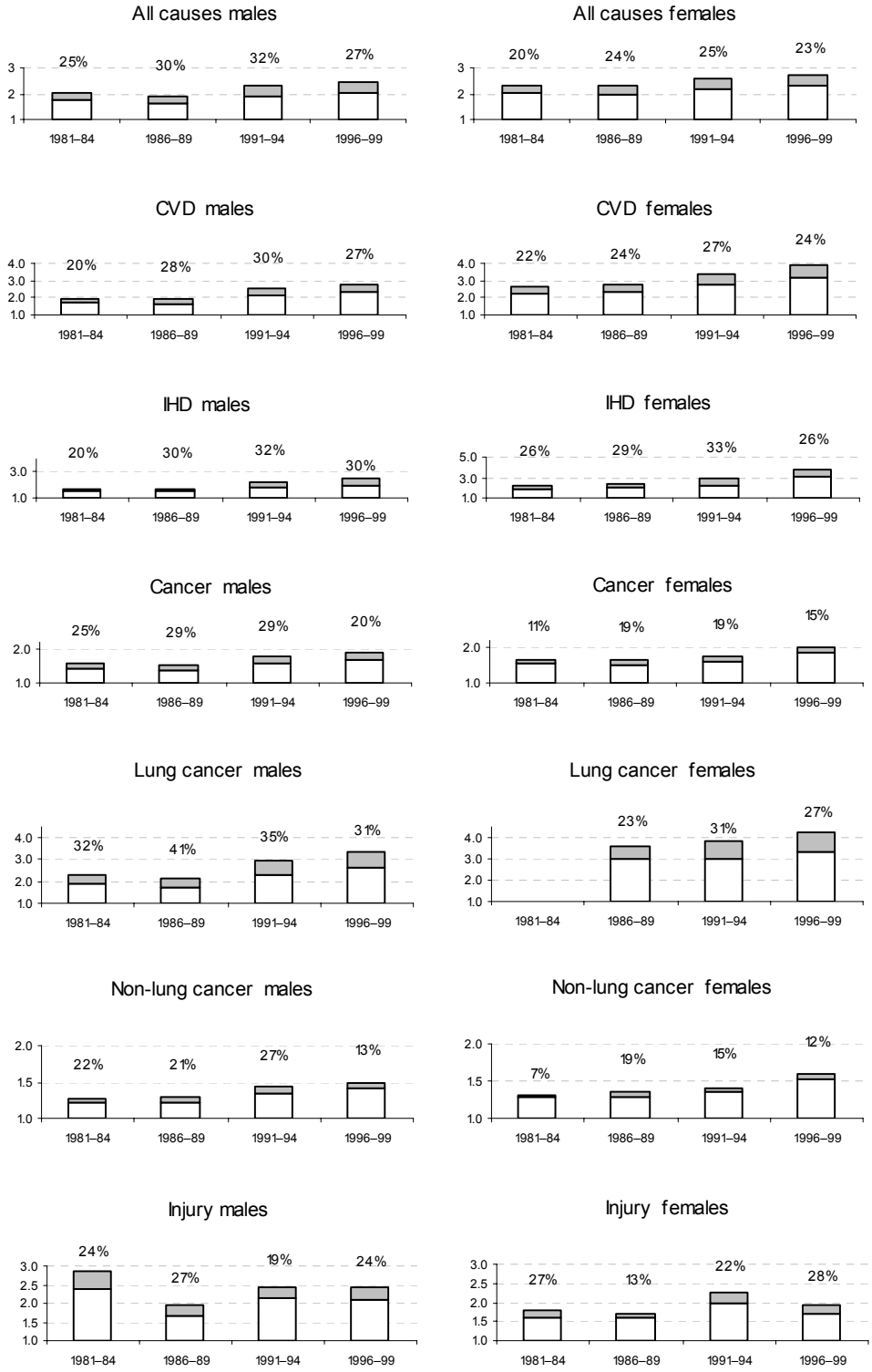
Figure 15 shows that the contribution of socioeconomic factors to cardiovascular (including IHD) mortality inequalities between Māori and non-Māori non-Pacific ethnic groups was very similar to the all-cause contribution. This finding applies also to injury mortality, except for males in 1991–94, when it was smaller.

By contrast, the contribution of socioeconomic factors to the ethnic inequality in cancer mortality is relatively smaller, especially for non-lung cancer in 1996–99 for males and for all four cohorts for females.

Overall summary

- In summary, the apparent extent of mediation of ethnic inequalities in mortality by socioeconomic position depends on which indicators of socioeconomic position are included in the regression model.
- When the maximum possible number of indicators is included in the model, the socioeconomic indicators account for up to 50% of the ethnic disparity in all-cause inequality. These analyses were, of necessity, limited to the working-age cohort (ages 25–59 years).
- Ethnic inequalities in mortality increased over the study period (ie, the 1980s and 1990s), as did ethnic inequalities in socioeconomic position. Nevertheless, the latter appears to explain only about one-third to one-half of the former, mostly through the increasing disparity in labour market position in the 1990s.
- The impact of socioeconomic inequalities on ethnic inequalities in mortality is apparent for most major cause of death groupings, although relatively more so for cardiovascular diseases and injuries than for cancers, especially non-lung (ie, non-tobacco-attributable) cancers.

Figure 15: Reduction in RR for Māori compared to non-Māori non-Pacific ethnic groups for models including and excluding socioeconomic variables



Note: The full height of each bar shows the RR for the model, including age and RHA only (model A). The non-shaded area is the RR for the model including income, education, car access and housing tenure (model B). The percentages refer to the percentage reduction in the RR for model B compared to model A.

Discussion

Summary of main findings

Research question 1: What were the socioeconomic distributions of the Māori and non-Māori populations during the study period (1981–1999), and were there any trends in these distributions over time?

Māori were disproportionately represented in the lower socioeconomic strata (however measured) in all cohorts. The relative socioeconomic disadvantage of Māori increased from 1981–84 to 1991–94, before easing slightly in the late 1990s. This probably reflects the structural changes to the New Zealand economy in the 1980s and early 1990s, whereby Māori were disproportionately affected by job losses in primary and manufacturing industries.

Research question 2: What were Māori and non-Māori mortality rates at each level of socioeconomic stratification, and how did these rates change over time?

Within socioeconomic strata, Māori mortality rates were higher than non-Māori mortality rates. That is, inequalities in mortality persist within strata of socioeconomic position. In general, non-Māori mortality rates decreased over time by about the same proportion in all socioeconomic strata. By contrast, among Māori there was a tendency, especially for 25–59-year-olds, for steeper mortality reductions in high than in low socioeconomic strata.

Research question 3: What were the inequalities between Māori and non-Māori mortality rates at each level of socioeconomic stratification, and how did these inequalities change over time?

In absolute terms, the difference between Māori and non-Māori mortality rates increased over time among lower socioeconomic strata (ie, among those with low income, who were unemployed, with no educational qualifications and without access to a car). Because Māori are more likely to occupy disadvantaged socioeconomic positions, this widening gap affects a large proportion of the Māori population. By contrast, within high socioeconomic strata, ethnic differences in mortality remained roughly stable over time.

Research question 4: Does the association between socioeconomic position and mortality vary between Māori and non-Māori, and were there any trends in these associations over time?

On a *relative* scale, there was no general trend for socioeconomic mortality gradients (ie, ratios of rates) to be different for Māori and non-Māori. However, when disparities are considered on an *absolute* scale (ie, differences in rates), the gap in mortality between advantaged and disadvantaged positions was often greater for Māori than for non-Māori.

Table 13 summarises trends in the SRR for the four main socioeconomic measures within ethnic groups. The arrows show statistically significant changes. In summary, no instances of a decline in relative inequality were found. By contrast, several instances of increasing relative inequality in mortality between low and high socioeconomic strata were found, affecting all age-by-sex-by-ethnicity groups. The fact that fewer instances of increasing SRRs were found among Māori is probably a function of statistical power rather than a true difference.

Table 13: Summary of trends over time in the SRRs for low compared to high socioeconomic position, among Māori and non-Māori

SRR for low compared to high SEP	Males				Females			
	25–59 years		60–77 years		25–59 years		60–77 years	
	Māori	Non-Māori	Māori	Non-Māori	Māori	Non-Māori	Māori	Non-Māori
Income	↑	↑	–	↑	–	↑	–	↑
Qualifications	–	↑	–	–	–	↑	–	–
Car access	↑	↑	–	↑	–	–	–	↑
Housing tenure	↑	↑	–	↑	–	–	–	–

Research question 5: What proportion of the inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was mediated by socioeconomic inequality, on average, over the study period?

When socioeconomic position was measured by the combined effect of income, education, car access and household tenure, the contribution of socioeconomic position to the relative inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was between one-fifth and one-third. The higher contribution was found among males, and among 25- to 59-year-olds.

The addition of small-area deprivation to the above models, which was only possible for the 1991–94 and 1996–99 cohorts, accounted for about an extra 10% of the ethnic inequality in mortality. For 25- to 59-year-olds, position in the labour market also accounted for a further 10% to 15% of the ethnic inequality in mortality. Collectively, therefore, the joint contribution of all measurable socioeconomic factors (income, education, car access, housing tenure, position in the labour market and small-area deprivation) to the ethnic inequality in mortality was 55% and 50% for working-age males and 43% and 41% for their female counterparts in 1991–94 and 1996–99 respectively.

Research question 6: How much of the increase in inequality in mortality between the Māori and the non-Māori non-Pacific ethnic groups was attributable to increasing socioeconomic inequality over the study period?

Among 25- to 59-year-olds, there was some evidence that the contribution of income, education, housing tenure and car access to Māori : non-Māori non-Pacific disparities in mortality *increased* up to 1991–94, and then possibly waned slightly in 1996–99 (Table 7, page 44). The addition of position in the labour market strengthened this finding of an increasing contribution of socioeconomic position up to 1991–94. Over half of the increase in ethnic inequality in mortality over the study period can be attributed to concomitant widening in socioeconomic inequalities (mainly related to labour force status), at least for working-age males. For females and older people of both sexes, widening of socioeconomic inequalities accounts for less than half and less than one-third of the increase in the ethnic mortality disparity, respectively.

Summarising further, the five most important findings of this report are as follows.

1 Māori were disproportionately represented in lower socioeconomic strata (eg, lower income, no qualifications, no car access), however measured. As a consequence, Māori are disproportionately affected by the health consequences of lower socioeconomic status.

2 Māori : non-Māori inequalities in mortality persist within socioeconomic strata.

3 Socioeconomic gradients in mortality exist within both Māori and non-Māori ethnic groups.

4 The different socioeconomic resources or positions of Māori and non-Māori non-Pacific ethnic groups account for at least half of the ethnic disparities in mortality for working-age adults and one-third for older adults.

5 Widening inequalities in socioeconomic resources between Māori and non-Māori non-Pacific ethnic groups during the 1980s and 1990s explained about one-third to one-half of the widening in the mortality disparity between these ethnic groups, at least for people of working age.

Comparison with other New Zealand studies

The findings in this report extend those from previous New Zealand research and are consistent with the earlier research.

Crampton and Salmond (1999) showed that the European ethnic group is over-represented in low deprivation areas while the reverse is true for Māori and Pacific ethnic groups. That is, a clear *distribution gap* of socioeconomic resources exists when measured by small-area deprivation. Furthermore, Tobias and Cheung (2003) found that the gap in life expectancy during 1995–97 between Māori and European ethnic groups was greater in more deprived areas. For males, this gap was 5.8 years in less deprived areas (weighted average across NZDep deciles 1–7) compared to 8.2 years in the most deprived decile areas. For females, the gap was 5.3 years and 10.1 years, respectively.

In this report, we also found that the *absolute* gap in mortality rates between Māori and non-Māori was often greater for more disadvantaged income and education groups – especially for the 25–59 years age group. However, this pattern was not found consistently using proxy measures of household wealth (car access and housing tenure).

Pearce and colleagues have reported greater social class inequalities in mortality for Māori than non-Māori (Pearce et al 1984, 1985, 1993; Sporle et al 2002). Their results also support the contention that higher mortality for Māori relative to non-Māori cannot be explained purely by the over-representation of Māori in lower social classes.

A number of studies have considered the effect of incorporating socioeconomic variables in analyses to examine the relative risk of mortality for Māori compared to non-Māori (or non-Māori non-Pacific ethnic groups). Blakely et al determined the contribution of small-area deprivation to ethnic differences in mortality during 1991–94. The reduction in the SRRs comparing Māori to non-Māori non-Pacific ethnic groups after standardising for deprivation was greatest at younger ages (eg, 58% for 0- to 24-year-old females) and least for older ages (eg, 22% for 55- to 74-year-old females) (Blakely et al 2002). These authors asserted that adjusting for multiple socioeconomic factors would account for a greater proportion of ethnic inequalities in mortality; our analysis is consistent with that assertion.

Pearce et al found that inclusion of occupational class in multivariate models reduced Māori to non-Māori non-Pacific mortality rate ratios by only 19% for 1975–77, increasing to 30% in 1985–87 (Pearce et al 1984, 1985, 1993; Sporle et al 2002). It is interesting to note that the proportion of ethnic differences in mortality attributable to occupational class increased over time – consistent with our analysis – although one has to be wary of selection and numerator–denominator biases in the unlinked analyses of Pearce and colleagues (Blakely and Fawcett 2005).

Interpretation and policy implications

The key findings of this report relate to (1) the average contribution of socioeconomic position to ethnic disparities in mortality and (2) trends in this contribution over time. Each finding is discussed in turn, including limitations and possible sources of error, issues in interpretation and implications for policy and monitoring.

The average contribution of socioeconomic position to ethnic disparities in mortality

> The different socioeconomic resources or positions of Māori and non-Māori non-Pacific ethnic groups account for at least half of the ethnic disparities in mortality for working-age adults and one-third for older adults.

According to the theoretical framework of health inequality used for this study (Figure 1, page 3), we should expect some degree of socioeconomic mediation of ethnic inequalities in mortality because the social forces that produce socioeconomic privilege and disadvantage are linked inherently to the position of ethnic groups in the social and political history of our country. However, we found that substantial differences remain between Māori and non-Māori mortality rates even after socioeconomic position is taken into account. Even when multiple measures of socioeconomic position were included in the regression models, less than one-half of the ethnic mortality disparity was found to be mediated by socioeconomic position. A naīve interpretation of these results might be that that much of the ethnic disparity in mortality is not mediated through socioeconomic factors. More specifically, one might conclude that half or more of the ethnic disparity in mortality among 60- to 77-year-olds is attributable to factors other than socioeconomic position and, likewise, up to half the disparity among 25- to 59-year-olds. In fact, our analysis almost certainly underestimates the total contribution of socioeconomic position to the ethnic inequality in mortality, for several reasons.

First, inclusion of deprivation in the regression models for the 1991–94 and 1996–99 cohorts demonstrates that addition of an extra socioeconomic variable explains about 10% more of the ethnic mortality disparity. By extension, it is likely that the addition of, say, a good measure of asset wealth would explain still more of the ethnic mortality disparity. The car access and household tenure variables included in our analyses provide a limited and imprecise measure of wealth but were the best available in the census data. That each additional socioeconomic measure has additional explanatory power in our models points to the difficulty of fully capturing socioeconomic pathways with only a few variables. It also illustrates the importance of measuring *multiple* dimensions of socioeconomic position to gain a full understanding of the pathways connecting ethnicity and health outcomes.

Second, we know from a rapidly accumulating body of research on life-course determinants of health that socioeconomic position at all points of the life course is important for health (Kuh et al 2003). Moreover, there are intergenerational effects of socioeconomic position on mortality risk, so the impacts of colonisation and the cumulative effects of historical socioeconomic disadvantage experienced by earlier generations may affect the health and mortality of current and future generations. Unfortunately, census data do not include measures of socioeconomic position over the life course or across generations, so our analysis is unable to take account of the life-course and intergenerational effects of socioeconomic position.

Third, we have shown that socioeconomic position appears to mediate more of the ethnic inequality in mortality for working-age males than for other demographic subgroups. This raises the question as to whether the census-based measures of socioeconomic position used in our study are equally as valid for females and for older people as for working-age males. In particular, many of the socioeconomic variables used in our analyses have narrower distributions for females and people aged 60–77 years than for working-age males. For example in the 1981–84 cohort, 90% of Māori females and 75% of non-Māori females aged 60–77 years had no qualifications, making education relatively insensitive as a measure of socioeconomic position for these groups.

Fourth, the socioeconomic categories available to us are fairly broadly defined. Even within the same category (for example, an income band), Māori may be concentrated toward the lower end of the category rather than uniformly distributed across it. Such residual confounding within socioeconomic strata would again lead us to underestimate the contribution of socioeconomic inequality to ethnic inequality in mortality outcomes.

Finally, apart from small-area deprivation, the measures of socioeconomic position used in our study are measured at the level of the individual or household. As such, they may not fully capture the wider disadvantage experienced by Māori (on average) at the family/whānau, neighbourhood and community level.

In summary, 'socioeconomic position' in our study is subject to measurement and misclassification bias compared to the ideal – as in all studies. Such biases have almost certainly resulted in incomplete quantification of socioeconomic position as a mediating or pathway variable for ethnic inequality in mortality. Moreover, this bias is likely to be greater for older age groups and for females. So, even in the NZCMS, one of few data sets in the world with sufficient statistical power and range of socioeconomic measures to examine the contribution of socioeconomic position to ethnic disparities in mortality, this contribution is still likely to be underestimated.

While we cannot quantify the extent of underestimation, it is highly unlikely on both empirical and theoretical grounds that *all* ethnic disparities in mortality in New Zealand are mediated solely by socioeconomic factors. Returning to our theoretical framework (page 3), it can be seen that lifestyle behaviours, psychosocial stress and health system performance all represent pathways to health. These pathways are all contingent to a variable degree on socioeconomic influences. However, it is probable that other, non-socioeconomic factors also channel the way that basic structural forces influence these pathways to health. For example, historical patterns of population geography, including ethnic variations in place of residence, have influenced the location of hospitals and health services. These historically determined locations now influence the accessibility of services for today's population. The coverage and quality of health services will explain some of the ethnic inequality in mortality independently of socioeconomic position.

What, then, are the likely explanations for ethnic disparities in mortality that may operate at least partially independently of socioeconomic resources?

Lifestyle (health-related behaviours)

Not surprisingly, health-related behaviours, such as smoking, diet and physical activity, have strong influences on health. These behaviours are themselves strongly conditioned by socioeconomic factors. For example, smoking is much more prevalent in socioeconomically disadvantaged groups; hence smoking and socioeconomic position are strongly correlated. As a result, when both smoking and socioeconomic position are included in regression models, the additional contribution of smoking independently of socioeconomic position is small. Elsewhere it has been shown using the linked NZCMS data sets that smoking is an important pathway explaining some of the socioeconomic differences in mortality (Blakely and Wilson 2005). However, the contribution of smoking to ethnic inequalities in mortality is much smaller (Hunt et al 2005). Thus the contribution smoking makes to ethnic disparities in mortality that is not already captured by socioeconomic position is modest (probably less than 10%).

Beyond tobacco smoking, diet, alcohol consumption and possibly physical activity may all contribute to ethnic mortality inequalities through pathways that are both dependent on and independent of socioeconomic position. However, their contribution to the latter is likely to be even smaller than that of tobacco consumption.

Psychosocial stress

The biological effect of chronic and cumulative stressors on physiological functioning is a key mechanism linking the social environment to health outcomes (McEwen 1998, 2003; Seeman et al 2004). Psychosocial stressors include those arising from poverty, from rapid social change and major life events, and the direct effects of racism. The increasing importance of labour force status as a factor accounting for ethnic inequalities in mortality, observed in this report, may reflect not only the material disadvantages of unemployment but also the psychosocial stressors associated with loss of work. The higher rates of suicide for the unemployed (Blakely et al 2003) provide evidence consistent with psychosocial factors being an important mediator between socioeconomic position and mortality. Among psychosocial stressors, the personal experience of racial discrimination has been shown to elicit strong physiological stress responses (Clark et al 1999). The impact of racism on ethnic inequalities in health is therefore likely to be mediated through both socioeconomic (institutionalised racism) and non-socioeconomic (interpersonal and internalised racism) pathways (Krieger 2002).

Health system access and quality

There is growing evidence that differential access to, and the quality of, health services contributes to ethnic inequalities in health. In the United States, a substantial body of evidence demonstrates many differences in health care utilisation between blacks and whites for a range of conditions (Smedley et al 2002). For example, physicians may unconsciously activate racial stereotypes in patient consultations, resulting in discriminatory treatment or referral patterns. Screening programmes may vary in coverage across ethnic groups despite similar need. Accumulated over the life course and across services, even small differences in health care may have substantial effects on health and so contribute to ethnic inequalities in health outcomes.

There is some evidence for such differential health care in New Zealand. For example, Māori and Pacific people have similar – and in the past lower – rates of coronary artery bypass grafts and angioplasty for ischaemic heart disease (Bramley et al 2004; Tukuitonga and Bindman 2002; Westbrooke et al 2000) compared to European New Zealanders, despite having greater need, as shown by their higher rates of ischaemic heart disease mortality (Ajwani et al 2003; Blakely et al 2005). Survival from cancer, even after adjusting for age and stage, has been found to be lower among Māori than non-Māori (Cormack et al 2005; Jeffreys et al 2005) for a number of cancer types. Both these findings point to probable differences in access to, and quality of, health care that may culminate in different outcomes for Māori compared to non-Māori.

Racial discrimination

A growing body of literature now confirms the health consequences of racial/ethnic discrimination on health. Krieger (2002) proposes five main pathways through which discrimination influences health: (1) economic and social deprivation, (2) exposure to toxic substances and hazardous conditions, (3) socially inflicted trauma – ranging from verbal to violent, (4) targeted marketing of legal and illegal psychoactive substances and other commodities, and (5) inadequate health care.

In terms of the theoretical model informing our analyses (see page 3), discrimination may in fact be considered a basic cause of structural inequalities in society. As such, racial discrimination may be expected to impact on health through a wide range of pathways, some mediated through socioeconomic position (ie, a racialised social order) and others independent of socioeconomic factors. This is particularly relevant to our study as it highlights the need to examine the factors leading to unequal distributions of socioeconomic resources by ethnicity in the first place, as well as those factors that act independently of socioeconomic position. The Ministry of Health is currently investigating the prevalence of perceived racial discrimination in New Zealand and how this may impact differentially on the health of different ethnic groups (Harris et al a and b).

The increasing contribution of socioeconomic position to ethnic disparities in mortality during the 1980s and 1990s

> Widening inequalities in socioeconomic resources between Māori and non-Māori during the 1980s and 1990s explained approximately one-third to one-half of the increase in the mortality disparity between these ethnic groups, depending on age and sex.

Our analysis demonstrates that widening socioeconomic inequalities contributed to widening ethnic inequalities in mortality – at least for males of working age. It is possible that the census-based measures of socioeconomic position available to us were simply too insensitive to demonstrate an increasing contribution of socioeconomic inequalities to ethnic mortality inequalities over time among older people (and to a lesser extent among females of all adult ages). Alternatively, it may be that the widening mortality inequalities observed among older people over time were more a function of other health determinants (cohort effects) or of health determinants acting earlier in the life course.

Focusing on the working-age population (and males in particular), it is plausible that serious health consequences resulted from the widening ethnic inequalities over the 1980s and 1990s in employment, education, income, and housing (Howden-Chapman and Tobias 2000; Mowbray 2001; Statistics New Zealand 1999; Te Puni Kōkiri 2000). For example, using Household Labour Force Survey data, Māori unemployment rose from 10.7% in 1986 to a peak of 25.4% in 1992, remained above 15% for the rest of the 1990s, and fell back to 10.2% by 2003 (Ministry of Social Development 2004). By contrast, unemployment was lowest among Europeans (the vast majority of the non-Māori group); their unemployment rate rose from 3.2% in 1986 to a peak of 7.9% in 1992 and had declined to 3.5% by 2003. Thus, the economic restructuring of the 1980s and 1990s resulted in high unemployment for Māori. Furthermore, we found an increasing contribution of labour market position to ethnic mortality inequalities over time. Taken together, these facts strengthen the argument that ethnic inequalities in mortality were adversely affected by the economic restructuring of the 1980s and early 1990s.

International studies provide ample evidence that rapid social change may harm population health, and that these effects may be strongest in disadvantaged sections of the population. The social upheaval in the former Soviet Union was associated with increasing mortality rates from many causes of death (most notably cardiovascular and injury (Notzon et al 1998)). Rates of death have since fallen and then risen again in concert with the economic cycle (Men et al 2003). Increased binge alcohol drinking has been implicated as one likely mechanism, but tobacco use, diet, psychosocial stress and health system factors are also likely explanations (Cockerham 1997; Shkolnikov et al 2001). The health impacts of the social upheaval were most apparent among people of lower socioeconomic position (Plavinksi et al 2003; Shkolnikov et al 1998). For example, Shkolnikov et al report that between 1988–89 and 1993–94 in Russia the standardised mortality ratios (using 1988–89 as the reference period) increased among less educated males by 57% compared to a smaller 35% increase among more highly educated males. Among females, these increases were also greater among the less educated (30% compared to 8%) (Shkolnikov et al 1998).

In New Zealand the social changes during the 1980s and 1990s were far more muted than events in the former Soviet Union, but the structural reforms clearly impacted most severely on the socioeconomic position of Māori and Pacific peoples. The actual mechanisms whereby the structural reforms were embodied in health disparities are likely to be manifold, and almost certainly involved a mix of factors acting through both socioeconomic and non-socioeconomic pathways. The disintegration of social networks, social cohesion and social integration brought about by increased unemployment, enforced (work-related) migration and family breakdown are examples of pathways that may act (in part) independently of socioeconomic position, yet even these factors are likely to impact more severely on health if accompanied by material deprivation.

Conclusion

This report demonstrates that differential access to socioeconomic resources accounts for much, but not all, of the disparities in mortality between Māori and non-Māori.

This finding is consistent with theoretical expectations and previous research. Higher mortality rates among Māori cannot be reduced to differences between Māori and non-Māori in socioeconomic position. Rather, this study confirms that socioeconomic position and ethnicity exert both joint and independent effects on mortality, acting through multiple pathways. It follows that both socioeconomic and ethnic determinants of health need to be addressed – through appropriate economic and social (including health) policies – if health inequalities between ethnic groups and social classes are to be reduced and ultimately eliminated.

This study also shows that, for working-age males at least, increasing socioeconomic disparities, particularly in relation to labour market position, over the 1980s and 1990s explains up to one-half of the observed increase in the ethnic mortality differential that occurred over this period. Policies designed to achieve full employment are therefore of particular salience for reducing health inequalities.

From a monitoring perspective, the data sets and analytical tools employed in this report can be used to assess whether ethnic and socioeconomic mortality disparities are increasing or reducing over time as further data accumulates with each census–mortality record linkage. The methods applied in this report can also be used to monitor the changing contributions of socioeconomic and non-socioeconomic pathways to the observed ethnic inequalities in mortality.

Appendix

Table A1: Percentage of cohorts with missing values according to the measure of socioeconomic position, by sex, age and ethnic group

Sex	Age	SEP measure	Māori				Non-Māori			
			1981–84	1986–89	1991–94	1996–99	1981–84	1986–89	1991–94	1996–99
Males	25–77 years	Car access	12.7	7.3	7.3	7.7	9.2	6.1	5.7	8.7
		Social class	20.6	21.4	42.5	36.5	20.0	20.7	29.0	30.1
		Education level	2.2	7.8	2.2	2.0	1.6	5.8	2.1	5.6
		Income level	29.8	25.6	22.7	24.5	19.9	15.9	15.7	18.9
		Labour force status			0.0	0.0			0.0	3.6
		Housing tenure	6.5	6.4	6.6	6.9	5.0	5.4	5.3	8.6
	25–59 years	Car access	12.6	7.3	7.4	7.7	9.1	6.0	5.5	8.6
		Social class	15.7	16.2	38.5	32.3	8.2	7.7	16.8	20.1
		Education level	1.9	7.1	1.9	1.8	1.2	4.6	1.7	5.5
		Income level	29.5	25.7	22.9	24.3	19.6	17.0	16.8	19.3
		Labour force status			0.0	0.0			0.0	3.7
		Housing tenure	6.6	6.4	6.7	6.9	5.0	5.3	5.2	8.4
	60–77 years	Car access	13.9	7.5	6.9	7.8	9.5	6.4	6.3	9.2
		Social class	64.9	68.9	79.6	71.1	62.7	67.6	73.1	68.1
		Education level	4.8	14.5	4.5	3.7	2.8	10.1	3.4	5.9
		Income level	32.8	24.5	20.8	25.6	21.0	12.0	11.8	17.3
		Labour force status			0.0	0.0			0.0	3.5
		Housing tenure	5.5	6.0	6.4	7.1	5.1	5.4	5.9	9.6
Females	25–77 years	Car access	11.2	4.9	4.6	5.2	8.2	4.6	4.2	6.8
		Social class	57.6	53.8	61.5	52.3	54.8	49.6	49.2	44.8
		Education level	2.5	10.3	2.6	2.0	1.7	8.3	2.4	4.9
		Income level	27.7	24.6	21.1	24.3	18.2	14.4	14.2	17.7
		Labour force status			0.0	0.0		0.0	0.0	3.1
		Housing tenure	3.4	3.8	3.8	4.1	3.2	3.7	3.8	6.7
	25–59 years	Car access	10.7	4.6	4.4	4.9	7.0	4.0	3.7	6.4
		Social class	54.2	49.8	58.4	48.7	44.2	37.1	37.3	34.0
		Education level	2.2	9.5	2.2	1.7	1.1	6.5	1.7	4.7
		Income level	27.4	24.9	21.3	24.1	17.7	15.8	15.5	18.2
		Labour force status	.	.	0.0	0.0	.	0.0	0.0	3.2
		Housing tenure	3.3	3.6	3.6	3.9	2.7	3.3	3.3	6.2
	60–77 years	Car access	15.6	7.7	6.5	7.5	11.7	6.4	5.7	8.5
		Social class	86.7	88.3	88.6	81.7	86.6	88.9	89.0	84.0
		Education level	5.0	17.1	5.8	4.7	3.4	14.1	4.8	5.9
		Income level	30.0	22.4	18.9	26.0	19.7	10.3	9.9	15.9
		Labour force status							0.0	2.8
		Housing tenure	4.2	5.5	5.4	6.1	4.4	4.7	5.2	8.6

Table A2: Mortality rate (95% CI), by income level – males

Age	Cohort	Income level	Māori		Non-Māori	
25–77 years	1981–84	Low	1851	(1671–2032)	1201	(1167–1235)
		Medium	1869	(1530–2207)	961	(926–996)
		High	1278	(1011–1545)	837	(804–871)
	1986–89	Low	1734	(1577–1891)	1100	(1070–1129)
		Medium	1518	(1325–1712)	911	(884–939)
		High	1214	(925–1503)	738	(706–770)
	1991–94	Low	1856	(1720–1992)	971	(946–996)
		Medium	1537	(1308–1767)	773	(745–800)
		High	1361	(976–1746)	597	(572–623)
	1996–99	Low	1830	(1709–1951)	850	(827–874)
		Medium	1424	(1261–1587)	669	(644–694)
		High	874	(697–1050)	506	(483–529)
25–59 years	1981–84	Low	939	(815–1063)	427	(398–457)
		Medium	708	(591–825)	350	(329–370)
		High	692	(565–819)	293	(277–310)
	1986–89	Low	767	(661–873)	387	(361–413)
		Medium	699	(606–791)	324	(305–342)
		High	544	(443–644)	272	(257–288)
	1991–94	Low	851	(763–940)	371	(347–394)
		Medium	657	(564–749)	280	(262–298)
		High	430	(351–509)	214	(201–227)
	1996–99	Low	857	(768–946)	330	(308–353)
		Medium	592	(512–672)	241	(224–259)
		High	358	(299–416)	182	(171–193)
60–77 years	1981–84	Low	5371	(4637–6105)	4185	(4068–4302)
		Medium	6345	(4766–7924)	3321	(3171–3472)
		High	3537	(2335–4739)	2935	(2785–3085)
	1986–89	Low	5463	(4819–6108)	3849	(3747–3950)
		Medium	4680	(3811–5549)	3178	(3065–3291)
		High	3800	(2451–5148)	2533	(2391–2675)
	1991–94	Low	5732	(5168–6296)	3286	(3204–3368)
		Medium	4934	(3878–5989)	2673	(2560–2785)
		High	4953	(3107–6799)	2076	(1961–2190)
	1996–99	Low	5582	(5106–6058)	2855	(2778–2931)
		Medium	4634	(3903–5364)	2317	(2217–2418)
		High	2865	(2037–3692)	1757	(1653–1861)

Table A3: Mortality rate (95% CI), by income level – females

Age	Cohort	Income level	Māori		Non-Māori	
25–77 years	1981–84	Low	1390	(1234–1545)	659	(637–680)
		Medium	1243	(977–1509)	575	(546–604)
		High	754	(530–979)	529	(498–560)
	1986–89	Low	1286	(1160–1412)	632	(613–652)
		Medium	1108	(912–1303)	553	(531–574)
		High	886	(545–1227)	469	(439–498)
	1991–94	Low	1236	(1132–1341)	561	(544–577)
		Medium	1234	(1023–1445)	476	(454–498)
		High	897	(574–1220)	394	(372–417)
	1996–99	Low	1257	(1159–1356)	504	(489–519)
		Medium	940	(795–1085)	412	(393–431)
		High	918	(643–1193)	338	(316–360)
25–59 years	1981–84	Low	573	(486–660)	229	(210–247)
		Medium	444	(353–535)	208	(192–224)
		High	388	(293–482)	172	(159–186)
	1986–89	Low	542	(465–618)	218	(201–234)
		Medium	377	(310–445)	192	(178–205)
		High	283	(210–356)	140	(129–152)
	1991–94	Low	536	(475–597)	200	(186–215)
		Medium	432	(358–507)	164	(151–177)
		High	255	(194–316)	128	(118–138)
	1996–99	Low	498	(441–555)	186	(173–199)
		Medium	346	(286–406)	149	(137–161)
		High	240	(191–289)	110	(102–118)
60–77 years	1981–84	Low	4206	(3584–4828)	2140	(2069–2211)
		Medium	3996	(2855–5137)	1840	(1725–1955)
		High	2018	(1074–2963)	1758	(1628–1888)
	1986–89	Low	3852	(3357–4347)	2061	(1997–2125)
		Medium	3624	(2788–4459)	1795	(1710–1880)
		High	2964	(1469–4459)	1601	(1477–1725)
	1991–94	Low	3648	(3234–4062)	1803	(1749–1857)
		Medium	3997	(3094–4900)	1553	(1467–1639)
		High	3110	(1689–4531)	1312	(1217–1406)
	1996–99	Low	3874	(3481–4267)	1599	(1548–1650)
		Medium	2987	(2377–3598)	1319	(1246–1391)
		High	3257	(2046–4467)	1125	(1030–1219)

Table A4: Māori compared to non-Māori – standardised rate differences within income groups

Sex	Age	Income level	Cohort							
			1981–84		1986–89		1991–94		1996–99	
Males	25–77 years	Low	650	(467–834)	634	(474–794)	885	(747–1023)	980	(856–1103)
		Medium	907	(567–1247)	607	(412–802)	765	(534–996)	755	(590–921)
		High	441	(171–710)	476	(186–767)	764	(378–1150)	368	(190–546)
	25–59 years	Low	512	(384–639)	380	(271–490)	481	(389–572)	527	(435–618)
		Medium	358	(239–477)	375	(281–469)	377	(282–471)	351	(269–433)
		High	399	(271–527)	271	(170–373)	216	(136–296)	176	(117–235)
	60–77 years	Low	1186	(442–1929)	1615	(962–2267)	2446	(1876–3016)	2727	(2244–3209)
		Medium	3024	(1438–4610)	1502	(626–2378)	2261	(1199–3322)	2316	(1579–3054)
		High	602	(-609–1813)	1266	(-90–2623)	2877	(1028–4727)	1108	(274–1941)
Females	25–77 years	Low	731	(574–888)	654	(526–782)	675	(570–781)	754	(654–853)
		Medium	668	(400–936)	555	(359–751)	758	(546–970)	528	(382–674)
		High	226	(-1–452)	417	(75–759)	503	(179–827)	580	(305–856)
	25–59 years	Low	344	(255–433)	324	(246–402)	336	(273–398)	312	(254–370)
		Medium	236	(144–329)	185	(116–255)	269	(193–344)	197	(136–258)
		High	215	(120–311)	143	(69–216)	127	(65–189)	130	(81–180)
	60–77 years	Low	2066	(1439–2692)	1791	(1292–2290)	1845	(1428–2263)	2275	(1879–2671)
		Medium	2157	(1010–3303)	1829	(989–2668)	2444	(1537–3351)	1669	(1054–2284)
		High	260	(-693–1214)	1363	(-137–2863)	1798	(374–3222)	2132	(918–3346)

Table A5: Mortality rates (95% CI), by education level (two groups)

Sex	Age	Cohort	Education	Māori		Non-Māori	
Males	25–77 years	1981–84	No qualifications	1824	(1695–1952)	1116	(1094–1138)
			Qualifications	1403	(1117–1689)	929	(900–958)
		1986–89	No qualifications	1683	(1557–1809)	1068	(1043–1093)
			Qualifications	1179	(1018–1340)	862	(841–882)
		1991–94	No qualifications	1814	(1693–1936)	954	(929–978)
			Qualifications	1491	(1324–1658)	758	(742–774)
		1996–99	No qualifications	1770	(1667–1873)	826	(804–847)
			Qualifications	1365	(1252–1477)	649	(634–664)
	25–59 years	1981–84	No qualifications	840	(769–910)	398	(381–415)
			Qualifications	538	(433–643)	304	(289–320)
		1986–89	No qualifications	753	(687–820)	385	(366–404)
			Qualifications	571	(490–652)	283	(271–295)
		1991–94	No qualifications	787	(723–852)	344	(324–363)
			Qualifications	538	(473–604)	247	(237–258)
		1996–99	No qualifications	787	(724–849)	317	(299–336)
			Qualifications	491	(440–542)	205	(196–214)
	60–77 years	1981–84	No qualifications	5620	(5056–6183)	3886	(3802–3969)
			Qualifications	4740	(3410–6070)	3339	(3212–3466)
		1986–89	No qualifications	5269	(4716–5822)	3700	(3602–3797)
			Qualifications	3526	(2810–4242)	3093	(3005–3181)
		1991–94	No qualifications	5775	(5239–6311)	3306	(3210–3402)
			Qualifications	5165	(4395–5936)	2726	(2659–2794)
		1996–99	No qualifications	5564	(5127–6001)	2788	(2712–2864)
			Qualifications	4735	(4225–5245)	2362	(2299–2426)
Females	25–77 years	1981–84	No qualifications	1367	(1246–1488)	664	(648–680)
			Qualifications	1180	(797–1564)	542	(517–567)
		1986–89	No qualifications	1321	(1209–1433)	645	(628–662)
			Qualifications	966	(747–1185)	524	(505–544)
		1991–94	No qualifications	1328	(1227–1428)	606	(588–624)
			Qualifications	884	(753–1016)	459	(446–473)
		1996–99	No qualifications	1304	(1214–1395)	528	(513–543)
			Qualifications	975	(865–1086)	411	(399–424)
	25–59 years	1981–84	No qualifications	510	(458–562)	228	(216–239)
			Qualifications	427	(335–518)	179	(167–192)
		1986–89	No qualifications	501	(450–551)	209	(197–221)
			Qualifications	320	(256–383)	161	(151–171)
		1991–94	No qualifications	522	(475–569)	203	(191–215)
			Qualifications	323	(273–373)	144	(137–152)
		1996–99	No qualifications	441	(400–482)	190	(178–202)
			Qualifications	348	(307–389)	129	(122–136)
	60–77 years	1981–84	No qualifications	4320	(3812–4829)	2167	(2109–2225)
			Qualifications	3779	(2102–5456)	1792	(1690–1893)
		1986–89	No qualifications	4149	(3682–4616)	2147	(2084–2211)
			Qualifications	3193	(2245–4142)	1777	(1697–1856)
		1991–94	No qualifications	4104	(3686–4521)	1995	(1929–2061)
			Qualifications	2818	(2259–3377)	1545	(1491–1598)
		1996–99	No qualifications	4280	(3904–4656)	1693	(1640–1745)
			Qualifications	3138	(2668–3609)	1385	(1333–1437)

Table A6: Mortality rates (95% CI), by car access – males

Age	Cohort	Number of cars	Māori		Non-Māori	
25–77 years	1981–84	Nil cars	2307	(1971–2642)	1371	(1303–1440)
		1 car	1661	(1500–1822)	1030	(1007–1052)
		≥ 2 cars	1617	(1389–1846)	873	(842–904)
	1986–89	Nil cars	1731	(1494–1968)	1496	(1419–1573)
		1 car	1602	(1462–1741)	965	(943–986)
		≥ 2 cars	1317	(1142–1493)	807	(783–832)
	1991–94	Nil cars	2090	(1834–2346)	1423	(1346–1501)
		1 car	1675	(1538–1812)	851	(831–871)
		≥ 2 cars	1480	(1300–1660)	663	(644–683)
	1996–99	Nil cars	2309	(2073–2546)	1253	(1184–1322)
		1 car	1674	(1558–1790)	753	(734–772)
		≥ 2 cars	1206	(1098–1314)	565	(548–581)
25–59 years	1981–84	Nil cars	984	(786–1181)	487	(435–539)
		1 car	724	(641–807)	348	(333–364)
		≥ 2 cars	772	(663–880)	306	(289–323)
	1986–89	Nil cars	747	(604–890)	569	(504–634)
		1 car	722	(647–798)	332	(316–348)
		≥ 2 cars	635	(555–715)	282	(268–296)
	1991–94	Nil cars	908	(756–1061)	582	(514–650)
		1 car	704	(633–774)	302	(286–317)
		≥ 2 cars	583	(515–651)	227	(216–238)
	1996–99	Nil cars	938	(799–1078)	493	(437–549)
		1 car	750	(678–823)	263	(247–278)
		≥ 2 cars	504	(451–557)	197	(188–207)
60–77 years	1981–84	Nil cars	7410	(5969–8850)	4782	(4517–5048)
		1 car	5275	(4559–5991)	3657	(3568–3747)
		≥ 2 cars	4880	(3851–5908)	3062	(2926–3197)
	1986–89	Nil cars	5527	(4515–6539)	5069	(4792–5347)
		1 car	4994	(4380–5607)	3404	(3322–3487)
		≥ 2 cars	3949	(3156–4742)	2833	(2725–2940)
	1991–94	Nil cars	6646	(5553–7740)	4668	(4397–4939)
		1 car	5421	(4812–6030)	2970	(2895–3045)
		≥ 2 cars	4943	(4109–5776)	2346	(2260–2432)
	1996–99	Nil cars	7598	(6581–8614)	4183	(3925–4440)
		1 car	5236	(4745–5727)	2644	(2572–2716)
		≥ 2 cars	3914	(3428–4399)	1981	(1912–2050)

Table A7: Mortality rates (95% CI), by household tenure (two groups)

Sex	Age	Cohort	SEP level	Māori		Non-Māori	
Males	25–77 years	1981–84	Owned	1770	(1630–1911)	994	(976–1012)
			Not owned	1691	(1480–1902)	1177	(1131–1222)
		1986–89	Owned	1575	(1454–1696)	906	(890–922)
			Not owned	1467	(1298–1636)	1146	(1100–1193)
		1991–94	Owned	1688	(1566–1809)	772	(757–786)
			Not owned	1601	(1439–1763)	1025	(983–1068)
		1996–99	Owned	1463	(1374–1551)	663	(649–676)
			Not owned	1817	(1665–1970)	871	(835–906)
	25–59 years	1981–84	Owned	791	(713–870)	330	(318–342)
			Not owned	737	(644–830)	390	(364–416)
		1986–89	Owned	723	(656–789)	310	(299–322)
			Not owned	647	(567–728)	352	(327–378)
		1991–94	Owned	683	(624–741)	264	(254–274)
			Not owned	686	(606–766)	309	(285–333)
		1996–99	Owned	598	(546–649)	226	(216–236)
			Not owned	749	(675–823)	274	(254–293)
	60–77 years	1981–84	Owned	5546	(4935–6157)	3552	(3478–3626)
			Not owned	5373	(4415–6331)	4211	(4013–4408)
		1986–89	Owned	4861	(4335–5388)	3205	(3140–3271)
			Not owned	4629	(3869–5389)	4210	(4008–4411)
		1991–94	Owned	5564	(5019–6109)	2729	(2672–2786)
			Not owned	5132	(4410–5854)	3789	(3604–3974)
		1996–99	Owned	4799	(4418–5180)	2347	(2295–2398)
			Not owned	5938	(5254–6622)	3173	(3020–3326)
Females	25–77 years	1981–84	Owned	1205	(1076–1334)	587	(573–601)
			Not owned	1444	(1243–1645)	706	(673–738)
		1986–89	Owned	1127	(1020–1234)	544	(531–556)
			Not owned	1314	(1144–1484)	724	(690–758)
		1991–94	Owned	1143	(1049–1238)	481	(470–492)
			Not owned	1192	(1041–1344)	591	(562–621)
		1996–99	Owned	1055	(976–1134)	417	(407–427)
			Not owned	1356	(1212–1499)	542	(516–569)
	25–59 years	1981–84	Owned	458	(403–513)	194	(185–203)
			Not owned	520	(444–596)	238	(217–259)
		1986–89	Owned	390	(345–435)	175	(167–183)
			Not owned	505	(437–573)	201	(181–221)
		1991–94	Owned	456	(412–500)	156	(149–163)
			Not owned	440	(380–500)	179	(161–197)
		1996–99	Owned	376	(340–412)	136	(130–143)
			Not owned	402	(353–452)	171	(156–186)
	60–77 years	1981–84	Owned	3779	(3238–4321)	1940	(1886–1994)
			Not owned	4629	(3775–5483)	2318	(2194–2443)
		1986–89	Owned	3668	(3219–4117)	1816	(1768–1864)
			Not owned	4104	(3385–4822)	2526	(2391–2661)
		1991–94	Owned	3513	(3122–3903)	1600	(1557–1642)
			Not owned	3785	(3144–4426)	2011	(1895–2128)
		1996–99	Owned	3395	(3068–3723)	1382	(1344–1421)
			Not owned	4641	(4027–5255)	1823	(1716–1929)

Table A8: Mortality rates (95% CI), by labour force status (ages 25–59 only)

Sex	Cohort	Labour force status	Māori		Non-Māori	
Males	1981–84	Employed	636	(579–693)	309	(299–319)
		Unemployed	757	(511–1004)	481	(392–570)
	1986–89	Employed	564	(515–612)	276	(266–285)
		Unemployed	741	(515–967)	556	(461–650)
	1991–94	Employed	505	(456–555)	219	(211–228)
		Unemployed	594	(468–720)	338	(296–380)
	1996–99	Employed	442	(402–482)	187	(179–194)
		Unemployed	762	(618–906)	314	(268–360)
Females	1981–84	Employed	353	(298–407)	148	(139–157)
		Unemployed	478	(125–831)	238	(153–323)
	1986–89	Employed	284	(242–326)	139	(131–147)
		Unemployed	296	(163–428)	193	(152–234)
	1991–94	Employed	252	(213–291)	118	(111–125)
		Unemployed	350	(219–481)	132	(103–162)
	1996–99	Employed	232	(202–262)	105	(99–111)
		Unemployed	373	(268–477)	141	(111–172)

Table A9: Mortality rates (95% CI), by Elley–Irving occupational class (ages 25–59 only)

Sex	Age	Cohort	Class	Māori		Non-Māori	
Males	25–59 years	1981–84	Classes 1 and 2	497	(303–691)	257	(231–282)
			Class 3	467	(333–601)	284	(262–305)
			Class 4	634	(493–776)	323	(302–344)
			Classes 5 and 6	694	(615–773)	367	(345–390)
		1986–89	Classes 1 and 2	311	(187–436)	199	(181–217)
			Class 3	520	(398–642)	267	(248–286)
			Class 4	527	(424–630)	291	(272–311)
			Classes 5 and 6	624	(554–694)	341	(319–362)
		1991–94	Classes 1 and 2	391	(276–506)	191	(174–208)
			Class 3	464	(338–591)	201	(183–219)
			Class 4	442	(337–548)	231	(213–249)
			Classes 5 and 6	587	(511–663)	260	(240–279)
		1996–99	Classes 1 and 2	322	(236–408)	145	(132–158)
			Class 3	298	(213–383)	170	(154–186)
			Class 4	359	(279–438)	191	(175–207)
			Classes 5 and 6	550	(483–617)	242	(224–261)
Females	25–59 years	1981–84	Classes 1 and 2	289	(101–476)	147	(121–172)
			Class 3	280	(156–403)	150	(132–168)
			Class 4	336	(211–460)	161	(141–182)
			Classes 5 and 6	411	(331–491)	158	(140–176)
		1986–89	Classes 1 and 2	298	(166–431)	124	(105–142)
			Class 3	217	(131–303)	132	(118–145)
			Class 4	181	(108–255)	145	(127–163)
			Classes 5 and 6	321	(258–385)	150	(134–167)
		1991–94	Classes 1 and 2	217	(134–299)	106	(92–120)
			Class 3	151	(85–216)	115	(103–126)
			Class 4	263	(167–359)	126	(109–144)
			Classes 5 and 6	307	(239–376)	124	(109–140)
		1996–99	Classes 1 and 2	179	(122–235)	99	(87–111)
			Class 3	179	(123–236)	101	(92–111)
			Class 4	227	(151–303)	99	(85–112)
			Classes 5 and 6	287	(232–341)	116	(103–129)

Table A10: Mortality rates (95% CI), by RHA – males

Sex	Age	Cohort	RHA	Māori		Non-Māori	
Males	25–77 years	1981–84	Northern	1717	(1529–1905)	944	(916–972)
			Midland	1699	(1514–1885)	1017	(979–1056)
			Central	1990	(1712–2267)	1078	(1046–1110)
			Southern	1413	(1045–1782)	1134	(1099–1170)
		1986–89	Northern	1556	(1383–1729)	900	(874–926)
			Midland	1730	(1563–1896)	926	(891–961)
			Central	1527	(1329–1725)	998	(968–1027)
			Southern	1101	(841–1361)	1036	(1003–1070)
		1991–94	Northern	1693	(1525–1860)	769	(746–792)
			Midland	1778	(1612–1943)	802	(772–833)
			Central	1626	(1437–1815)	846	(820–872)
			Southern	1656	(1306–2006)	882	(854–911)
		1996–99	Northern	1607	(1473–1741)	624	(605–643)
			Midland	1740	(1609–1872)	670	(644–696)
			Central	1575	(1418–1731)	696	(673–719)
			Southern	1282	(1092–1472)	775	(749–801)
	25–59 years	1981–84	Northern	742	(639–845)	312	(294–330)
			Midland	780	(682–877)	344	(318–370)
			Central	863	(738–987)	353	(333–373)
			Southern	550	(388–712)	385	(363–408)
		1986–89	Northern	704	(616–791)	296	(280–313)
			Midland	764	(675–853)	305	(281–328)
			Central	683	(582–784)	326	(307–345)
			Southern	466	(339–592)	362	(340–384)
		1991–94	Northern	719	(635–803)	259	(244–274)
			Midland	754	(671–837)	278	(256–299)
			Central	653	(562–743)	276	(258–293)
			Southern	478	(364–591)	291	(272–310)
		1996–99	Northern	631	(563–700)	205	(193–217)
			Midland	728	(650–805)	234	(215–253)
			Central	677	(592–761)	233	(217–249)
			Southern	534	(431–637)	251	(234–269)
	60–77 years	1981–84	Northern	5479	(4656–6301)	3382	(3262–3501)
			Midland	5246	(4427–6066)	3614	(3457–3771)
			Central	6337	(5077–7596)	3873	(3738–4008)
			Southern	4745	(3067–6422)	4023	(3872–4174)
		1986–89	Northern	4843	(4072–5614)	3229	(3121–3338)
			Midland	5456	(4724–6187)	3321	(3178–3463)
			Central	4783	(3905–5662)	3588	(3463–3712)
			Southern	3551	(2386–4716)	3637	(3496–3778)
		1991–94	Northern	5449	(4702–6196)	2736	(2639–2832)
			Midland	5725	(4985–6465)	2826	(2705–2947)
			Central	5382	(4532–6231)	3047	(2939–3155)
			Southern	6202	(4558–7845)	3163	(3046–3280)
		1996–99	Northern	5371	(4776–5966)	2238	(2158–2319)
			Midland	5647	(5082–6211)	2353	(2251–2455)
			Central	5039	(4353–5726)	2479	(2386–2571)
			Southern	4165	(3333–4997)	2795	(2689–2901)

Table A11: Trends in RR for Māori to non-Māori non-Pacific, by cohort and cause of death, ages 25–77 years

Cause of death	Sex	Model	1981–84	1986–89	1991–94	1996–99	% increase in Māori to nMnP RR over five years
CVD	Males	A	1.93 (1.73–2.16)	1.92 (1.73–2.13)	2.58 (2.36–2.82)	2.80 (2.57–3.06)	1.134 (1.087–1.184)
		B	1.74 (1.55–1.95)	1.66 (1.49–1.85)	2.10 (1.91–2.31)	2.32 (2.12–2.54)	1.133 (1.085–1.182)
			20%	28%	30%	27%	1%
	Females	A	2.66 (2.30–3.06)	2.78 (2.45–3.17)	3.37 (3.00–3.78)	3.85 (3.43–4.31)	1.128 (1.068–1.191)
		B	2.29 (1.98–2.64)	2.36 (2.07–2.69)	2.74 (2.43–3.08)	3.16 (2.80–3.56)	1.120 (1.060–1.182)
			22%	24%	27%	24%	6%
IHD	Males	A	1.65 (1.44–1.89)	1.74 (1.53–1.97)	2.28 (2.05–2.55)	2.45 (2.20–2.73)	1.134 (1.077–1.195)
		B	1.52 (1.32–1.75)	1.52 (1.34–1.73)	1.87 (1.67–2.10)	2.02 (1.81–2.26)	1.132 (1.074–1.193)
			20%	30%	32%	30%	1%
	Females	A	2.08 (1.70–2.56)	2.40 (2.02–2.86)	2.85 (2.43–3.36)	3.73 (3.19–4.37)	1.181 (1.095–1.273)
		B	1.80 (1.46–2.22)	1.99 (1.67–2.37)	2.24 (1.90–2.65)	3.01 (2.56–3.55)	1.172 (1.086–1.264)
			26%	29%	33%	26%	5%
Cancer	Males	A	1.55 (1.31–1.82)	1.52 (1.33–1.75)	1.80 (1.60–2.01)	1.87 (1.69–2.07)	1.057 (1.000–1.117)
		B	1.41 (1.19–1.67)	1.37 (1.19–1.57)	1.57 (1.40–1.77)	1.70 (1.53–1.88)	1.057 (1.000–1.117)
			25%	29%	29%	20%	0%
	Females	A	1.64 (1.39–1.93)	1.63 (1.42–1.87)	1.75 (1.56–1.96)	1.98 (1.79–2.20)	1.050 (0.992–1.111)
		B	1.57 (1.32–1.86)	1.51 (1.31–1.74)	1.61 (1.43–1.81)	1.83 (1.64–2.03)	1.049 (0.991–1.110)
			11%	19%	19%	15%	2%
Lung cancer	Males	A	2.27 (1.74–2.96)	2.18 (1.73–2.74)	2.96 (2.44–3.58)	3.32 (2.81–3.94)	1.132 (1.033–1.240)
		B	1.86 (1.42–2.45)	1.70 (1.34–2.15)	2.27 (1.86–2.77)	2.59 (2.17–3.08)	1.129 (1.030–1.237)
			32%	41%	35%	31%	2%
	Females	A	4.76 (3.39–6.68)	3.60 (2.71–4.80)	3.84 (3.07–4.81)	4.21 (3.46–5.13)	0.99 (0.887–1.109)
		B	– –	3.00 (2.23–4.02)	2.96 (2.34–3.74)	3.34 (2.72–4.10)	0.99 (0.885–1.107)
				23%	31%	27%	--
Non-lung cancers	Males	A	1.27 (1.03–1.56)	1.29 (1.09–1.53)	1.45 (1.26–1.67)	1.48 (1.31–1.68)	1.038 (0.968–1.113)
		B	1.21 (0.98–1.50)	1.23 (1.03–1.46)	1.33 (1.15–1.54)	1.42 (1.25–1.62)	1.038 (0.968–1.113)
			22%	21%	27%	13%	0%
	Females	A	1.30 (1.07–1.58)	1.36 (1.16–1.60)	1.41 (1.23–1.62)	1.60 (1.42–1.81)	1.075 (0.989–1.170)
		B	1.28 (1.05–1.56)	1.29 (1.10–1.52)	1.35 (1.17–1.55)	1.53 (1.35–1.73)	1.073 (0.987–1.167)
			7%	19%	15%	12%	3%
Unintentional injury	Males	A	2.85 (2.16–3.75)	1.94 (1.50–2.51)	2.41 (1.90–3.06)	2.44 (1.93–3.09)	1.015 (0.910–1.133)
		B	2.40 (1.80–3.20)	1.69 (1.29–2.21)	2.14 (1.67–2.76)	2.10 (1.64–2.68)	1.013 (0.908–1.131)
			24%	27%	19%	24%	13%
	Females	A	1.81 (1.07–3.06)	1.70 (1.08–2.68)	2.25 (1.50–3.36)	1.95 (1.28–2.97)	1.090 (0.898–1.324)
		B	1.59 (0.93–2.74)	1.61 (1.01–2.57)	1.97 (1.29–3.02)	1.68 (1.08–2.60)	1.086 (0.894–1.319)
			27%	13%	22%	28%	4%
Suicide	Males	A	1.33 (0.78–2.27)	0.72 (0.41–1.26)	0.81 (0.52–1.24)	1.48 (1.07–2.04)	1.198 (0.975–1.471)
		B	1.19 (0.69–2.06)	0.63 (0.36–1.11)	0.64 (0.41–1.00)	1.24 (0.89–1.73)	1.192 (0.970–1.466)
			42%	-32%	-89%	50%	3%
	Females	A	0.48 (0.15–1.59)	0.55 (0.23–1.34)	0.71 (0.29–1.74)	1.67 (1.00–2.76)	1.672 (1.144–2.443)
		B	0.47 (0.14–1.57)	0.51 (0.21–1.28)	0.57 (0.23–1.45)	1.33 (0.78–2.26)	1.654 (1.131–2.419)
			-2%	-9%	-48%	51%	3%

Table A12: Trends in RR for Māori to non-Māori non-Pacific, by cohort and cause of death, ages 60–77 years

Cause of death	Sex	Model	1981–84	1986–89	1991–94	1996–99	% increase in Māori to nMnP RR over five years
CVD	Males	A	1.47 (1.25–1.73)	1.45 (1.24–1.69)	2.12 (1.88–2.40)	2.37 (2.11–2.65)	1.188 (1.120–1.261)
		B	1.35 (1.15–1.60)	1.26 (1.08–1.47)	1.77 (1.56–2.00)	2.00 (1.78–2.24)	1.188 (1.119–1.260)
			26%	42%	31%	27%	0%
	Females	A	2.19 (1.81–2.64)	2.32 (1.97–2.73)	2.63 (2.26–3.06)	3.40 (2.95–3.91)	1.147 (1.069–1.231)
		B	1.92 (1.59–2.33)	2.02 (1.71–2.38)	2.18 (1.86–2.54)	2.91 (2.52–3.37)	1.141 (1.063–1.224)
			23%	23%	28%	20%	4%
IHD	Males	A	1.36 (1.11–1.65)	1.36 (1.13–1.64)	1.85 (1.59–2.15)	2.18 (1.90–2.50)	1.179 (1.096–1.268)
		B	1.28 (1.05–1.56)	1.19 (0.99–1.44)	1.55 (1.33–1.81)	1.83 (1.59–2.11)	1.177 (1.095–1.266)
			22%	47%	35%	30%	1%
	Females	A	1.95 (1.52–2.49)	2.05 (1.66–2.54)	2.36 (1.93–2.88)	3.36 (2.79–4.03)	1.259 (1.106–1.433)
		B	1.71 (1.33–2.19)	1.74 (1.40–2.16)	1.89 (1.54–2.32)	2.83 (2.35–3.42)	1.223 (1.074–1.391)
			25%	30%	35%	22%	14%
Cancer	Males	A	1.53 (1.22–1.91)	1.34 (1.11–1.62)	1.71 (1.47–1.98)	1.73 (1.52–1.97)	1.057 (0.982–1.139)
		B	1.39 (1.11–1.75)	1.20 (0.99–1.46)	1.50 (1.28–1.74)	1.58 (1.39–1.80)	1.059 (0.983–1.140)
			26%	41%	30%	21%	-4%
	Females	A	1.73 (1.34–2.24)	1.57 (1.28–1.93)	1.73 (1.47–2.05)	1.87 (1.62–2.17)	1.092 (1.013–1.177)
		B	1.66 (1.28–2.16)	1.45 (1.17–1.79)	1.61 (1.36–1.91)	1.73 (1.49–2.01)	1.077 (0.999–1.160)
			10%	21%	16%	16%	16%
Lung cancer	Males	A	2.17 (1.55–3.02)	2.00 (1.49–2.67)	2.82 (2.23–3.57)	3.00 (2.45–3.67)	1.127 (1.006–1.262)
		B	1.83 (1.30–2.57)	1.56 (1.16–2.10)	2.23 (1.75–2.84)	2.37 (1.92–2.92)	1.126 (1.005–1.261)
			29%	44%	32%	32%	1%
	Females	A	4.72 (3.01–7.40)	3.71 (2.61–5.27)	3.45 (2.55–4.67)	3.91 (3.03–5.03)	0.953 (0.824–1.102)
		B	4.12 (2.60–6.53)	3.08 (2.15–4.42)	2.65 (1.94–3.61)	3.11 (2.40–4.04)	0.954 (0.825–1.104)
			16%	23%	33%	27%	2%
Non-lung cancers	Males	A	1.22 (0.90–1.65)	1.05 (0.82–1.36)	1.29 (1.06–1.57)	1.32 (1.12–1.56)	1.047 (0.979–1.119)
		B	1.16 (0.85–1.57)	1.01 (0.78–1.30)	1.18 (0.97–1.44)	1.27 (1.07–1.51)	1.046 (0.979–1.119)
			27%	80%	38%	16%	2%
	Females	A	1.31 (1.04–1.65)	1.47 (1.21–1.80)	1.36 (1.13–1.62)	1.76 (1.51–2.06)	1.060 (0.954–1.178)
		B	1.53 (1.06–2.23)	1.18 (0.86–1.62)	1.38 (1.03–1.85)	1.69 (1.34–2.14)	1.061 (0.955–1.179)
			-71%	62%	-6%	9%	-2%
Unintentional injury	Males	A	3.01 (1.40–6.47)	2.12 (0.97–4.61)	3.26 (1.78–5.96)	2.69 (1.50–4.81)	0.999 (0.745–1.341)
		B	2.73 (1.24–5.97)	1.83 (0.83–4.06)	3.15 (1.68–5.91)	2.44 (1.34–4.45)	1.002 (0.747–1.344)
			14%	26%	5%	15%	300%
	Females	A	0.39 (0.08–1.99)	1.82 (0.63–5.21)	2.70 (1.24–5.90)	0.91 (0.30–2.78)	1.171 (0.723–1.896)
		B	0.36 (0.07–1.87)	1.83 (0.63–5.30)	2.42 (1.08–5.40)	0.74 (0.24–2.29)	1.165 (0.720–1.887)
			-5%	-1%	16%	-189%	4%

Table A13: Trends in RR for Māori to non-Māori non-Pacific, by cohort and cause of death, ages 25–59 years

Cause of death	Sex	Model	1981–84	1986–89	1991–94	1996–99	Increase in Māori to nMnP RR over five years
CVD	Males	A	2.50 (2.14–2.91)	2.57 (2.23–2.97)	3.39 (2.98–3.85)	3.66 (3.20–4.18)	1.144 (1.076–1.216)
		B					
		E	2.10 (1.79–2.46)	2.07 (1.78–2.40)	2.32 (2.02–2.66)	2.64 (2.29–3.04)	1.101 (1.036–1.172)
			27%	32%	45%	38%	30%
	Females	A	3.64 (2.95–4.50)	3.89 (3.15–4.79)	5.31 (4.42–6.37)	5.31 (4.37–6.45)	1.147 (1.069–1.231)
		B					
		E	2.97 (2.38–3.71)	2.84 (2.27–3.55)	3.82 (3.14–4.66)	3.65 (2.96–4.49)	1.141 (1.063–1.224)
			25%	36%	35%	39%	4%
IHD	Males	A	1.85 (1.53–2.25)	2.22 (1.88–2.63)	3.00 (2.57–3.50)	2.97 (2.52–3.51)	1.168 (1.084–1.259)
		B					
		E	1.64 (1.35–2.01)	1.83 (1.53–2.19)	2.06 (1.75–2.43)	2.13 (1.79–2.54)	1.128 (1.046–1.217)
			25%	32%	47%	43%	24%
	Females	A	2.71 (1.95–3.76)	3.18 (2.37–4.26)	4.86 (3.67–6.43)	5.37 (4.00–7.20)	1.258 (1.106–1.431)
		B					
		E	2.13 (1.52–3.00)	– –	3.22 (2.38–4.36)	3.40 (2.48–4.66)	1.223 (1.076–1.391)
			34%		42%	45%	14%
Cancer	Males	A	1.65 (1.31–2.08)	1.73 (1.43–2.09)	2.04 (1.73–2.40)	2.10 (1.80–2.45)	1.092 (1.008–1.183)
		B					
		E	1.45 (1.14–1.84)	1.50 (1.23–1.83)	1.60 (1.35–1.90)	1.72 (1.47–2.02)	1.054 (0.972–1.143)
			31%	32%	42%	35%	41%
	Females	A	1.51 (1.22–1.87)	1.70 (1.42–2.04)	1.71 (1.47–2.00)	2.09 (1.82–2.40)	1.091 (1.013–1.176)
		B					
		E	1.42 (1.14–1.77)	1.60 (1.32–1.93)	1.50 (1.27–1.76)	1.89 (1.64–2.19)	1.077 (0.999–1.160)
			18%	14%	30%	18%	15%
Non-lung cancers	Males	A	1.40 (1.06–1.84)	1.58 (1.27–1.97)	1.71 (1.41–2.08)	1.63 (1.36–1.97)	1.044 (0.948–1.149)
		B					
		E	1.31 (0.99–1.74)	1.47 (1.17–1.85)	1.46 (1.19–1.79)	1.42 (1.17–1.72)	1.005 (0.912–1.108)
			23%	19%	35%	33%	89%
	Females	A	1.31 (1.04–1.66)	1.49 (1.22–1.82)	1.34 (1.12–1.61)	1.77 (1.51–2.07)	1.075 (0.988–1.170)
		B					
		E	1.28 (1.00–1.63)	1.42 (1.15–1.74)	1.21 (1.00–1.46)	1.65 (1.40–1.94)	1.060 (0.974–1.154)
			10%	14%	38%	16%	20%
Unintentional injury	Males	A	2.83 (2.10–3.82)	1.89 (1.44–2.49)	2.34 (1.81–3.02)	2.39 (1.85–3.08)	1.012 (0.898–1.140)
		B					
		E	2.15 (1.57–2.95)	1.55 (1.16–2.07)	1.91 (1.45–2.51)	1.90 (1.45–2.48)	1.009 (0.895–1.138)
			37%	38%	32%	35%	25%
	Females	A	2.23 (1.28–3.88)	1.54 (0.92–2.58)	2.20 (1.39–3.47)	2.31 (1.47–3.65)	1.106 (0.891–1.374)
		B					
		E	1.89 (1.06–3.39)	1.43 (0.83–2.45)	1.88 (1.15–3.07)	2.17 (1.34–3.52)	1.102 (0.888–1.369)
			28%	20%	27%	11%	4%
Suicide	Males	A	2.83 (2.10–3.82)	1.89 (1.44–2.49)	2.34 (1.81–3.02)	2.39 (1.85–3.08)	1.012 (0.898–1.140)
		B					
		E	2.15 (1.57–2.95)	1.55 (1.16–2.07)	1.91 (1.45–2.51)	1.90 (1.45–2.48)	1.009 (0.895–1.138)
			37%	38%	32%	35%	25%
	Females	A	2.23 (1.28–3.88)	1.54 (0.92–2.58)	2.20 (1.39–3.47)	2.31 (1.47–3.65)	1.106 (0.891–1.374)
		B					
		E	1.89 (1.06–3.39)	1.43 (0.83–2.45)	1.88 (1.15–3.07)	2.17 (1.34–3.52)	1.102 (0.888–1.369)
			28%	20%	27%	11%	4%

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