# Decades of Disparity II

## Socioeconomic mortality trends in New Zealand, 1981–1999

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http://www.wnmeds.ac.nz/nzcms-info.html

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# Foreword

In New Zealand, as elsewhere, inequalities in health exist between socioeconomic and ethnic groups, people living in different geographic areas, people belonging to different generations, and between males and females. These inequalities are not random: in all countries, socially disadvantaged and marginalised groups have poorer health, greater exposure to health risks, and lesser access to high-quality health services than their more advantaged counterparts.

*Decades of Disparity II: Socioeconomic mortality trends in New Zealand, 1981–1999* represents an important contribution to the health inequalities debate in this country. For the first time we have reliable estimates of *trends* in mortality by income, education and occupational class, based on linking individual-level mortality and census records. These trends can be broken down by age, gender and calendar year, and are presented for all causes of death and by cause – including causes responsive to health care intervention. The period covered in this report – the 1980s and 1990s – represents a period of major social change in New Zealand, which makes it especially relevant.

The report presents the results for four measures of inequality side by side: absolute and relative measures, and measures of effect and impact. Each measure tells a different story, and presenting them together enables different interpretations of the observed trends in inequality of survival chances to be considered. Overall, however, the key finding is one of increasing relative inequality in mortality from most major causes, with stable absolute inequality. Widening inequality in New Zealand's income distribution over the observation period has clearly contributed to this trend.

This monitoring report provides valuable evidence in support of the Government's Reducing Inequalities initiative, and specifically for the Ministry of Health's contribution to this initiative. It complements the first report in the *Decades of Disparity* series, published by the Ministry in 2003, which examined ethnic inequalities in mortality. The third and final report in the series, due for publication in 2005/06, will analyse the complex interaction between socioeconomic position and ethnic identity in determining survival chances in this country.

Comments on the current report on socioeconomic inequalities in mortality 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 (as part of her PhD on trends in cardiovascular disease by socioeconomic position using NZCMS data), and contributed to the study design, analyses, interpretation of results and write-up.

June Atkinson led the development of analytical procedures, undertook the analyses in the Data Laboratory of Statistics New Zealand, and contributed to the write-up.

Martin Tobias leads the Ministry of Health's collaboration on the NZCMS, and contributed to the study design, life-table and avoidable mortality analyses, and the interpretation, write-up and editing of this report.

Jit Cheung led the life-table analyses (life expectancy and cause-deleted life expectancy), and contributed to the interpretation and write-up of related sections of the report.

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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.

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# 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 1975 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.)

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# Executive Summary

*Decades of Disparity: Ethnic mortality trends in New Zealand 1980–1999,* described the widening mortality inequality between Māori and Pacific peoples compared to non-Māori non-Pacific people in New Zealand over the 1980s and 1990s. The current report, the second in the *Decades of Disparity* series, describes disparities and trends in mortality by socioeconomic position over this same period for the entire population (ie, all ethnic groups combined). A future report will thoroughly examine mortality rates by ethnic group and socioeconomic position simultaneously.

Socioeconomic inequalities in mortality have been increasing in developed countries during recent decades – at least in relative terms. In this report we have used New Zealand Census – Mortality Study data to estimate inequalities and trends in adult mortality by income, education and occupational class. We present results for each of the 1981–84, 1986–89, 1991–94 and 1996–99 periods, and focus on differences in mortality by a three-level grouping of income (where approximately a third of the population is in each income group).

We measured the disparities in mortality between income groups in both *absolute* and *relative* terms. Absolute inequalities are differences in mortality rates between low- and high-income people. Relative inequalities are the ratio of these mortality rates for low- compared to high-income people. Given that all-cause mortality rates in New Zealand are trending down for all socio-economic groups, then if absolute inequalities remain stable relative inequalities must increase[1]. If absolute inequalities increase over time, then relative inequalities must increase even more.

Overall, we found that:

- absolute socioeconomic inequalities in mortality among males and females aged 25–77 years were stable on average over the 1980s and 1990s,whereas relative inequalities increased
- relative inequalities in mortality among males and females aged 25–77 years increased more using income as the measure of socioeconomic position (approximately doubling) than using education
- increasing socioeconomic inequalities in all-cause mortality over time were most notable among 25–44-year-olds
- educational inequalities in mortality tended to be greater than income inequalities among 25–44-year-olds, while the opposite was found for 45–59 and 60–77-year-olds.

[1] A simple numerical example may clarify this:

| | Time One (rate per 1000) | Time Two (rate per 1000) | Interpretation |
|---|---|---|---|
| **Group A** | 200 | 150 | |
| **Group B** | 100 | 50 | |
| **Rate difference** | 100 (200 – 100) | 100 (150 – 50) | Stable absolute inequality |
| **Rate ratio** | 2.0 (200 / 100) | 3.0 (150 / 50) | Increasing relative inequality |

### All-cause mortality

The rate ratios for 25–77-year-olds, comparing low- to high-income groups, increased from 1.43 in 1981–84 to 1.72 in 1996–99 among males and from 1.27 to 1.50 among females.

### Life expectancy

Estimated life expectancy at birth (weighted for varying ethnic composition) increased during the 1980s and 1990s for all three income groups. Gaps in life expectancy between low- and high-income groups widened from 3.4 to 5.0 years for males but remained stable (or even slightly narrowed) from 2.9 to 2.7 years for females.

### All-cause mortality gradients by socioeconomic position and ethnicity

For the purposes of this report we checked whether the association of income and education with mortality was broadly similar between ethnic groups. In relative terms it was, but in absolute terms the income and education differences were greater among Māori.

### Avoidable, amenable and non-avoidable mortality

Mortality avoidable by prevention and treatment, and the subset of mortality amenable to health services interventions, declined dramatically over the 1980s and 1990s, with absolute inequalities remaining stable over time and relative inequalities more than doubling. This suggests that health services in the broadest sense may have made a substantial contribution to widening relative inequalities in mortality over the 1980s and 1990s.

### Cardiovascular disease

Relative inequalities by income among 25–77-year-old males increased steadily from a rate ratio of 1.38 in 1981–84 to 1.69 in 1996–99, whereas the rate ratio among females increased from 1.38 in 1981–84 to 1.54 in 1991–94, then fell to 1.40 in 1996–99. Absolute inequalities were roughly stable over time among males, but decreased among females (mostly driven by decreasing absolute inequalities among 60–77-year-old females).

### Cancer

Relative inequalities by income among 25–77-year-olds increased from a rate ratio of 1.28 to 1.53 among males, and from 1.09 to 1.41 among females. Absolute inequalities increased in parallel. (Background cancer mortality rates are not changing much over time.) Both lung and non-lung cancer contributed to the increasing inequalities by income. Increasing cancer inequalities by education were more muted than by income, but were still apparent.

### Unintentional injury

Trends varied by sex, age and type of injury. Inequalities by income at any one point in time were most pronounced for 25–44-year-old road traffic crash mortality (rate ratios ranging from 1.58 to 2.22). However, there were no clear trends over time in inequalities in unintentional injury mortality.

### Suicide

Inequalities by income varied by sex and age. They were greatest among 25–44 and 45–59-year-olds, with up to three-fold higher suicide rates among low- compared to high-income people at points during the 1980s and 1990s. Both absolute and relative inequalities in suicide increased markedly during the 1980s and 1990s among 25–44-year-olds. (Background suicide rates for young adults were increasing during the 1980s to 1990s.)

### Contribution of specific diseases to trends in inequality

Cardiovascular disease made the largest contribution to the total socioeconomic inequality in mortality – although its share decreased over time among females. The contribution of cancer increased over time and may overtake the contribution of cardiovascular disease in the near future. This prediction may be overturned if the obesity epidemic causes a reversal of the falling rates of cardiovascular disease mortality among (particularly) low socioeconomic groups.

### Policy implications

There are two main policy implications of the findings in this report. First, the results are consistent with the view that widening of the income distribution during the 1980s and 1990s exacerbated socioeconomic inequalities in health. Therefore it seems reasonable to predict that economic and labour market policies aimed at narrowing the income distribution will reduce socioeconomic inequalities in mortality. Second, trends in socioeconomic inequalities in mortality have varied by cause of death – and are likely to continue to do so. As the chronic disease most amenable to primary prevention and treatment, cardiovascular disease mortality among lower socioeconomic groups is a high priority if we are aiming to reduce inequalities in the future. Cancer mortality looms as a major driver of socioeconomic disparities in mortality in the coming decades. Policies and programmes to reduce overall cancer (both tobacco-related and non-tobacco-related) incidence and mortality need to be designed and implemented in such a way as to prevent the further emergence of socioeconomic inequalities in cancer mortality. Such policies and programmes include primary prevention, screening and access to new treatment modalities.

# Chapter 1: Introduction

## 1.1 Objectives

Reducing social inequalities in health is a central policy goal in New Zealand and other economically developed countries (Minister of Health 2000; Ministry of Health 2002c). In many such countries, social inequalities in health (measured in relative terms) have widened in recent decades (Drever and Whitehead 1997; Feldman et al 1989; Mackenbach et al 2003). This widening has often occurred despite improvements in access to and coverage of health services in these countries. In New Zealand, *ethnic* disparities in mortality have also been shown to have widened during the 1980s and 1990s, following a period of narrowing from the 1950s to the 1970s (Ajwani et al 2003). However, with the exception of limited research demonstrating a possible widening of mortality inequalities for 15–64-year-old males by occupational class (Pearce et al 2002), trends in *socioeconomic* disparities have been less clearly established for this country.

The purpose of this report is to describe and interpret trends in inequalities in mortality by income for New Zealand from1981 to 1999. We use income as one measure of the broader construct of socioeconomic position (Lynch et al 1994). This report is the second in a series of three major reports being produced collaboratively by the Wellington School of Medicine and Health Sciences of the University of Otago and the Public Health Intelligence group of the Ministry of Health. Two imperatives drive this collaboration: the Ministry's mandate to monitor and report on the health of the population (including its level and distribution) as part of its stewardship function, and the need to understand and interpret trends in social inequalities in health to both improve knowledge and assist policy.

The first report, *Decades of Disparity: Ethnic mortality trends in New Zealand 1980–1999,* described the widening mortality inequality between Māori and Pacific peoples compared to non-Māori non-Pacific peoples in New Zealand over the 1980s and 1990s (Ajwani et al 2003). The current (ie, second) report describes disparities and trends in mortality by socioeconomic position over this same time period. As a person's socioeconomic position may be influenced by their ethnicity, but (usually) not vice versa, we view ethnicity as prior to socioeconomic position in any causal understanding of health inequalities. This does not imply that ethnicity *per se* determines socioeconomic position, but that social forces correlated with ethnicity may impact on social stratification (Jones 2000; Krieger 2000; Kaufman and Cooper 1999; Blakely et al 2002). Given that the focus of this report is on the association of socioeconomic position with mortality, ethnicity is considered in epidemiological terms to be a *confounding* variable in the analyses. Accordingly, analyses reported here are either stratified or statistically adjusted for ethnicity.

The third report, to be published in 2005, will explore the complex interaction of ethnic identity with socioeconomic position in relation to mortality outcomes in greater depth. Taken together, the three reports should provide a comprehensive account of how ethnicity and socioeconomic position interact with age and gender to pattern the survival chances of New Zealanders, and how this social patterning of mortality has varied over time.

## 1.2 Rationale

Why is it important to monitor *inequalities* in mortality by socioeconomic position? The low mortality rates experienced by the powerful and privileged in New Zealand society provide a benchmark, indicating the level of survivorship that all socioeconomic groups could reasonably aspire to. Put another way, the higher mortality rates of low-income people identify deaths that are unnecessary and untimely – and whose occurrence may be viewed as unjust or unfair (Woodward and Kawachi 2000).

Beyond contributing to equity gains, reducing socioeconomic mortality gradients may be one of the best strategies for improving the average health status of New Zealanders as well. A general rule of thumb (based on numerous studies internationally) is that mortality rates among low-income working-age adults are typically about twice those of high-income adults, with a smooth gradient of increasing mortality rates from high to low socioeconomic groups. So if everyone enjoyed the same low mortality rates as those in the high socioeconomic group, the mortality rates for the population as a whole would be reduced by about one-third, raising the average life expectancy at birth by about four to five years (depending on the age structure of mortality). This simple example shows that a policy focus on social inequalities can improve both the average level and the distribution of health (mortality) in the population.

Why is it important to monitor *trends* in mortality by socioeconomic position? Trend data greatly enhance our understanding of social inequalities in health, and (most importantly) provide a pointer for the future. Disparity trends by cause of death are particularly important – as this report will show. Projecting from historical trends in cause-specific mortality by socioeconomic group can identify which causes of death are likely to be the major drivers of the socioeconomic mortality gradient over the next 10–20 years, so helping to guide us in formulating and evaluating evidence-based policies, setting priorities and allocating resources.

Why don't we already have sufficient information about trends in mortality by socioeconomic position in New Zealand? We already know there are large differences in mortality by small-area deprivation (Salmond and Crampton 2000) and other socioeconomic factors (Blakely et al 2002; Blakely 2002b) at any one point in time. We also have indicative evidence of persistent gaps in life expectancy by small-area deprivation over the 1990s (Salmond and Crampton 2000; Ministry of Health 1999), and of persistent if not widening gaps in male 15–64-year-old mortality by occupational class from 1974–78 to 1995–97 (Pearce et al 2002). However, trends in mortality by deprivation are not strictly comparable due to changing indices of deprivation over time. Also, deprivation indices combine personal and neighbourhood socioeconomic characteristics, precluding any judgement on trends at the level of individual socioeconomic position. Trends in mortality by occupational class using unlinked census and mortality data (ie, serial cross-sectional analyses) are also problematic because they can only be validly estimated for working-age males, and are prone to numerator–denominator bias resulting from occupation being recorded differently in the census and in the mortality record.

## 1.3 New Zealand Census – Mortality Study

The New Zealand Census – Mortality Study (NZCMS) provides the best opportunity to accurately and precisely estimate inequalities and trends in mortality by a range of individual-level socioeconomic measures, and for a range of causes of death. The NZCMS is a record linkage study of census and mortality records, providing individual-level data free of numerator–denominator bias, conducted collaboratively between Statistics New Zealand, the Ministry of Health and the Wellington School of Medicine and Health Sciences. It is conducted under strict privacy and confidentiality criteria, with all data securely stored on site at Statistics New Zealand (see security statement on page vi).

The NZCMS has created four census–mortality cohort studies for the periods 1981–84, 1986–89, 1991–94 and 1996–99. Briefly, all New Zealand census respondents aged 0–74 years are followed-up for mortality for a three-year period. As each of the four cohorts is large, and the census contains data on many socioeconomic variables, it becomes possible to examine socioeconomic inequalities for many causes of death using a variety of measures of socioeconomic position. Furthermore, each of the four census–mortality cohorts has the same study design, enabling robust comparisons to be made over time. As it takes time for mortality data to accrue and be finalised after each census, the 2001–04 cohort will only be available in 2005/06 at the earliest. However, given the major changes in social and mortality patterns that occurred in New Zealand over the 1980s and 1990s, the time period covered by the NZCMS to date is of particular interest.

## 1.4 Measurement of socioeconomic position

For the purposes of this report, we have elected to focus on disparities and trends in mortality by one traditional measure of socioeconomic position – income. A range of considerations influenced this choice.

- Income can be specified in the same way, and with the same inflation adjusted categories, for each of the four cohorts.
- The number of categories can be adjusted according to the statistical power requirements of the analysis (in this report we use both a three- and a five-category classification of income).
- The categories are clearly hierarchical.
- Income is more than just a marker of socioeconomic position – its distribution can be directly affected via income redistribution (taxation and benefit) policies, making this measure of particular policy salience.
- Rising income inequality has been a major feature of the dramatic social change experienced by New Zealanders during the 1980s and the early 1990s (Ministry of Health 1999; Mowbray 2001).

Both social class (often measured using *occupational* class) and education are also central to sociological theories of social position and stratification. We have included some analyses by these two socioeconomic factors in this report by way of comparison with the income results. Education and occupational class, however, pose measurement challenges. Educational level is measured as the highest completed educational qualification. Changes in the classification of qualifications, together with changing patterns of participation in education, produce significant cohort and period effects that are challenging when making comparisons over time. The assignment of an occupational class, when based on current occupation as in the NZCMS, is only measurable for people who are currently employed. Hence, occupational class analyses exclude people outside the active labour force and are also subject to severe health selection biases (Blakely 2002b; Kunst et al 1998; Martikainen and Valkonen 1999).

### 1.4.1 Income, education and class – separate socioeconomic factors, or different measures of 'socioeconomic position'?

Do income, education and class measure quite different 'exposures', or are they merely proxies for the same underlying latent variable? What can we learn by examining the differences (or similarities) of the associations of income, education and class with health? Do we measure income, education and class well enough to examine their independent associations with health? These questions are difficult, but must be addressed in a report such as this one.

Income, education and class in *theory* measure and capture different aspects of socioeconomic position that could be reasonably expected to have different causal paths to health status (Lynch and Kaplan 2000; Liberatos et al 1988). In *practice*, though, distinguishing between the differences in the association (conceptual to statistical) of these three socioeconomic factors with health is problematic – for a range of reasons. First, the crude (or even age- and ethnicity-adjusted) association of any of income, education or class with mortality will still include a large component of confounding by other variables, such as personality (Poulton and Caspi 2003; Pulkki et al 2003) and other socioeconomic factors (Blakely 2002b). Second, a range of other biases (eg, measurement error, health selection effects) affect each socioeconomic factor, and also affect each socioeconomic factor differently. Third, multivariable models that include income, education and class simultaneously in an attempt to determine the 'independent' effect of each socioeconomic factor are problematic. Measurement error of the correlated socioeconomic factors means that the independent effects of a socioeconomic factor 'may not be all they seem' (Davey Smith and Phillips 1990, 1992; Phillips and Davey Smith 1991, 1992; Marshall and Hastrup 1996, 1999; Robins and Greenland 1992; Cole and Hernán 2002; Blakely 2002a). Any variable is measured with error; socioeconomic factors are no exception, and indeed are prone to considerable measurement error.

The approach we take in this report is pragmatic. We consider income both as a stand-alone variable *and* as a measure of the more general underlying construct of socioeconomic position. We have to consider the former in the context of fiscal policies that alter people's incomes and the population's income distribution. (A consideration of the causal association of income with mortality necessarily invokes a consideration of confounding of the income–mortality association – an issue we consider in more detail in section 14.3 of the Discussion.) We are also interested in the general question, 'Did socioeconomic inequalities in mortality improve, stay the same, or worsen over the 1980s and 1990s?' Accordingly, we compare analyses of the association of education and class with mortality to those for income, looking for consistent patterns. If we do not find consistent patterns, we attempt to understand why. For example, we

might expect the association of education with mortality to be stronger at younger ages as the attainment of one's education occurs earlier in the life course.

## 1.5 Measurement of health outcomes

A full description of trends in socioeconomic gradients in health would include non-fatal as well as fatal outcomes. However, the NZCMS links only mortality to census data. While this provides a partial rather than a comprehensive picture of socioeconomic disparities in health, mortality is of course an important health outcome.

We have structured this report to present overall findings first for all causes of mortality combined, then for avoidable mortality, and finally for a number of specific causes of death. Within each section mortality rates (age-specific and age-standardised) are presented first, followed by relative and absolute measures of the strength of the income–mortality association. For all-cause mortality, we also present estimates of excess deaths, potential years of life lost, life expectancies at different ages, and probabilities of surviving different life-cycle stages.

## 1.6 Measurement of inequality

The strength of association between an 'exposure' and an 'outcome' can be measured in both *absolute* and *relative* terms. Absolute measures indicate the actual magnitude of the disparity (ie, rate differences measured in units such as 'per 100,000 person years'), while relative measures compare the relative size of the disparity (ie, ratios of rates).

Relative and absolute measures of inequality tell different stories, and policy advice needs to interpret these stories carefully. For example, given the long-term decline in overall mortality that has occurred over the past century, it would be expected that absolute differences between social groups (however constructed) would also decline. Therefore, it might be argued that 'unfairness' may be captured better through relative measures. Yet is this important if all groups are showing absolute improvement? Such debates are at the heart of any interpretation of trends in social inequalities in health, and (in our view) reinforce the need to present *both* absolute and relative measures (Mackenbach et al 1997a, 1997b; Vagero and Erikson 1997). (We consider the dynamic interrelationships between absolute and relative measures of inequalities when background mortality rates are changing further in section 1.7.)

In addition to this axis of absolute versus relative inequalities, there is another axis of measures of effect (or association) versus measures of impact (Mackenbach and Kunst 1997). The table below gives six measures of inequality by these two axes.

**Table 1:** Measures of inequality

| | Absolute | Relative |
|---|---|---|
| Effect/association | Rate difference | Rate ratio |
| ↑ | Slope index of inequality (SII) | Relative index of inequality (RII) |
| ↓ | | |
| Impact | Population-attributable risk or excess deaths | Population-attributable risk (% or relative version) |

Measures of impact are a function of both the strength of the exposure–outcome association *and* the distribution of the population by the exposure. The *population-attributable risk* (Hennekens and Buring 1987; Rothman and Greenland 1998) is a measure of the excess deaths that occur in the lower-income groups as a consequence of higher mortality rates than the high-income group. The population-attributable risk can be expressed either as the number of excess deaths (the absolute version – PAR) or as the percentage of all deaths that are excess deaths (the relative version – PAR%). When comparing trends over time, both the PAR and PAR% are affected by changes in the income distribution of the population over time. The absolute version, the PAR, is also affected by changes in the size of the population.

The *relative index of inequality* (RII)and the *slope index of inequality* (SII) overcome a number of technical problems inherent in both standard effect measures that compare categories (ie, rate ratios and rate differences) and the population-attributable risk family of impact measures. First, the regression-based calculation of the RII and SII utilises the mortality rates at all levels of income or education, rather than just comparing the mortality rates of the two extreme groups (ie, lowest compared to highest). Second, the RII and SII are not sensitive to variations in income, occupation and educational group sizes over time. This is because the RII and SII compare the hypothetical top-ranked and bottom-ranked persons by socioeconomic position – not the midpoints of the two extreme groups that may have changing sizes over time. Third, the RII and SII are less sensitive to changing definitions of the socioeconomic variable over time (eg, education), so long as a hierarchy of low to high socioeconomic status is maintained in the categorisation of the socioeconomic measure.

The RII and SII have features of both effect/associational measures and impact measures. On the one hand, they quantify the effect size for the hypothetical mortality risk comparing the lowest and highest ranking individuals by socioeconomic position. On the other hand, by using mortality rates for all categories of the total population they might also be viewed as impact measures.

Given the technical advantages of the RII and SII, we make extensive use of them in this report. It is important to note – and this will be reiterated at several points during this report – that because of the widening income distribution in New Zealand during the 1980s and 1990s (Statistics New Zealand 1999) the RII and SII would be expected to increase more over time than the corresponding rate ratio and rate difference. That is, as a greater proportion of the population experience the mortality rates at the extremes of the socioeconomic distribution, the total impact of socioeconomic inequalities in health increases.

In summary, we routinely present four measures of inequality in this report: rate differences, rate ratios, SIIs and RIIs. A consideration of all four measures together enables a more informed interpretation of the trends.

## 1.7 Interrelationship between absolute and relative inequalities when background mortality rates are changing

In most countries overall mortality rates are tending to fall over time. These background trends mean that if relative inequalities are constant over time, then absolute inequalities must decrease. Conversely, if absolute inequalities are constant over time, then relative inequalities must increase.

Figure 1 shows three scenarios of mortality trends over a long period (say 50 to 100 years) for low and high socioeconomic groups. Scenario (a) demonstrates linear decreasing trends in mortality, with a constant rate difference between low and high socioeconomic groups. The pattern seen in (a) for the first half of the x-axis (time) is not dissimilar to that seen in a number of countries in the later decades of the 20th century. Note that while absolute inequalities remain constant, relative inequalities increase, as shown by the superimposed relative risks. Clearly, the linear improvement in mortality rates shown in Figure 1(a) cannot continue indefinitely as mortality rates cannot fall below zero.

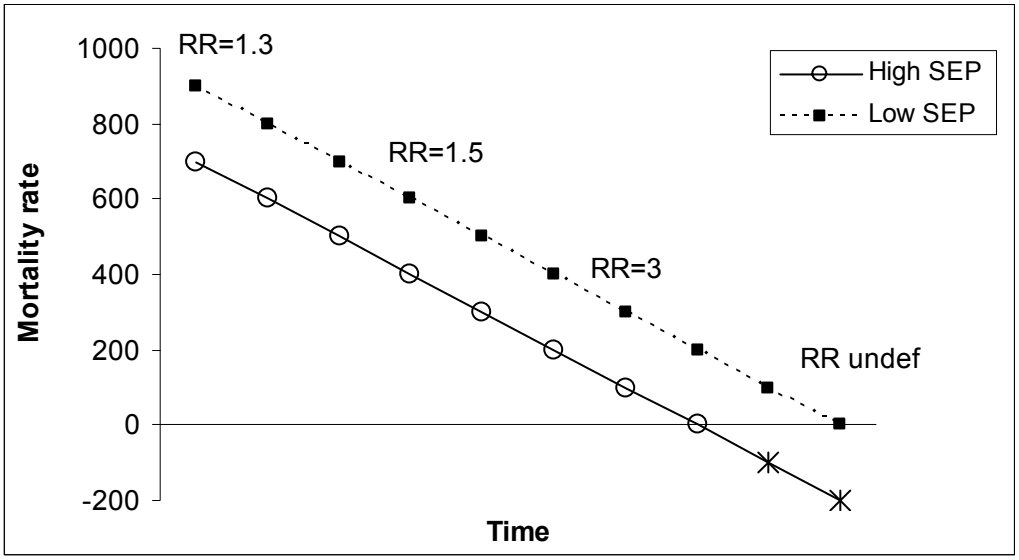
Figure 1(b) presents a variant of the 'inverse equity hypothesis' proposed by Victora et al (2000). These authors drew on their experience of child health programme implementation in South America together with the 'inverse care law' proposed by Hart (1971). They hypothesised that higher socioeconomic groups will take up public health programmes and interventions before low socioeconomic groups, and that low socioeconomic groups will only catch up with high socioeconomic groups once the latter have secured the maximum possible benefit from the new knowledge and initiatives. As a consequence, relative inequalities will initially rise. An optimistic scenario would be that at some future date low socioeconomic groups completely catch up with high socioeconomic groups (as shown in Figure 1(b)). A pessimistic scenario is that mortality rates among the low socioeconomic group will plateau out at a higher level than those achieved by the high socioeconomic group.

The inverse equity hypothesis is heuristically useful, but also simplistic. For example, it is likely that multiple new interventions occur at varying points of time, leading to more complex trends over time than shown in Figure 1(b). However, it is also likely that the inverse equity hypothesis will have applicability to chronic diseases in developed countries. For example, there have been profound decreases in ischaemic heart disease (IHD) mortality in developed countries in recent decades as a result of *both* changing health-related behaviours and improving treatments (Hunink et al 1997; Capewell et al 2000). It seems highly probable that high socioeconomic groups will benefit earlier and more rapidly than low socioeconomic groups, leading to a trend graph approximating that in Figure 1(b).

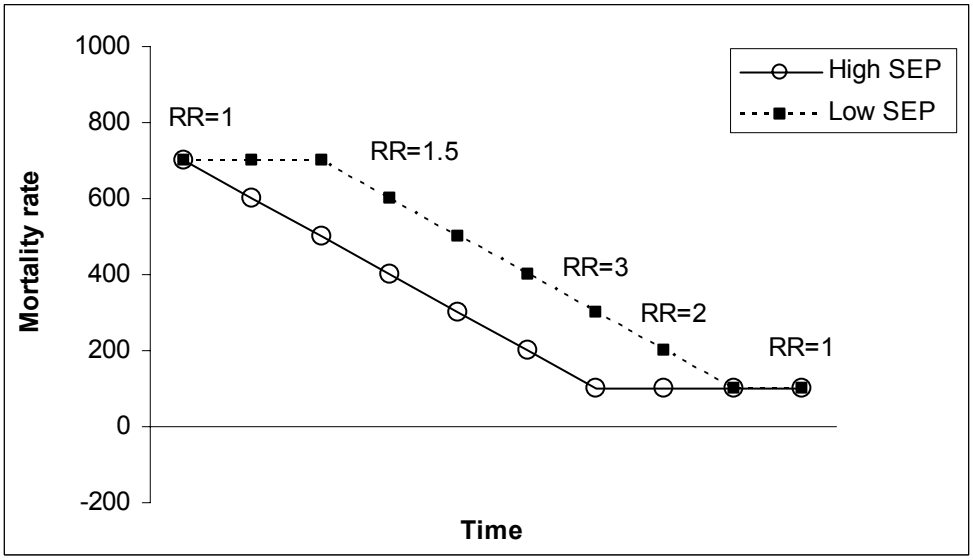
Figure 1(c) presents a 'phased epidemic' variant of the inverse equity hypothesis. For example, consider the IHD epidemic that afflicted developed countries in the 20th century (and has more recently spread to developing countries). While there is no conclusive proof, it is likely that rates increased first among high socioeconomic groups; ie, IHD was initially a disease of affluence. Over time, and with greater understanding of the aetiology and treatments, IHD mortality began to fall – probably first for the higher socioeconomic group. Should this phased epidemic variant be true, then during the period of most rapid decline in IHD one might see approximately constant absolute differences in IHD mortality between socioeconomic groups, but rising relative inequalities. However, at some point in time absolute and relative inequalities might start decreasing again – so long as the low socioeconomic group completely (or nearly completely) catches up with the high socioeconomic group.

**Figure 1:** Scenarios of mortality rate trends for high and low socioeconomic groups

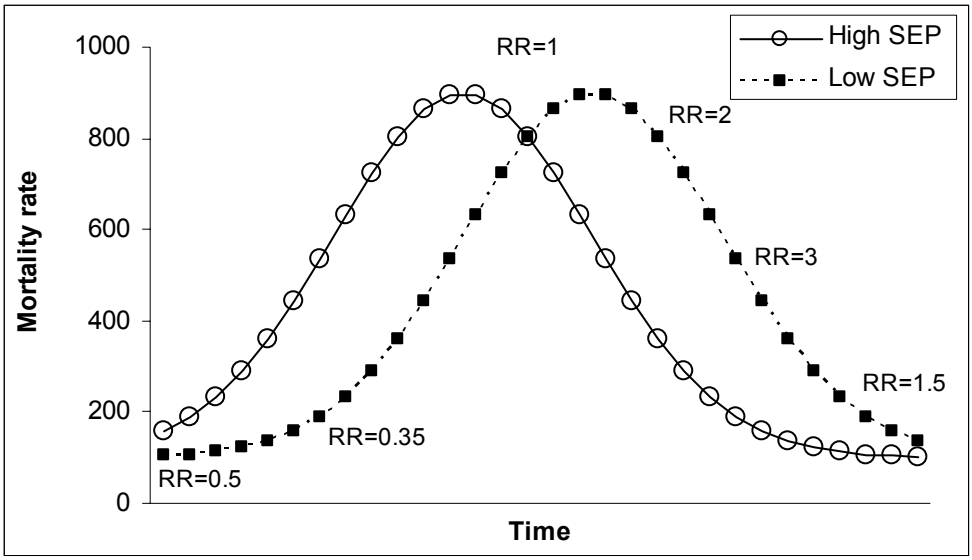
(a) Linear decreases in mortality rates with constant absolute rate difference




(b) Inverse equity hypothesis (Victora et al 2000)



(c) Mortality epidemics out of phase for high and low socioeconomic groups




Notes: RR = relative risk; SEP = socioeconomic position.

There are several reasons why the scenarios shown above are important in relation to this report. First, they emphasise that over the long run socioeconomic mortality gradients are likely to be dynamic. While the NZCMS permits comparisons over 20 years (a rare opportunity internationally), it is important to recognise that the patterns observed in this report are just one segment of time in the longer-term scenarios. We have no strong reason to expect that what we observe in the 1980s and 1990s would apply to earlier decades and – most importantly – to future decades. Second, we must interpret the findings in this report in the context of long-term trends. This is particularly important for diseases such as IHD, which have shown such marked declines over time. But it is also important for cancers, where there is a (slowly) improving understanding of aetiological risk factors and improving treatments. Also, unintentional injury mortality rates have decreased notably in recent decades, and there have been marked and complex changes in suicide rates.

Third, to aid our interpretation of findings in this report we make extensive use of statistical tests of trend in absolute (ie, standardised rate difference (SRD) and slope index of inequality (SII)) and relative (ie, standardised rate ratio (SRR) and relative index of inequality (RII)) measures of inequality over the 1980s and 1990s. While these tests are a useful aid, we must be aware of the likely dynamic patterns in absolute and relative inequalities over time. This is a challenge given we have only four points in time to compare, limiting the statistical power to confidently state, for example, that absolute inequalities increased and then decreased over the study period. Our *a priori* position, therefore, is to look more closely for such dynamic trends over time in absolute and relative measures of inequality for IHD and total cardiovascular mortality – the causes of death for which we might expect such patterns to be evident within a (relatively short) 20-year period. In particular, we might expect to see declines in absolute inequalities in IHD and cardiovascular disease before any declines in relative inequalities.

## 1.8 From description to explanation

The purpose of this report is to describe and interpret trends in inequalities in mortality by income for New Zealand from 1981 to 1999. To provide interpretation and explanation, we have invited commentaries from leading New Zealand experts in areas such as cardiovascular disease, cancer, injury, suicide, public health policy and health services research. These commentaries (included as text boxes in the Discussion chapter of the report) focus on possible explanations for the changing disparities by socioeconomic position that we have observed during the 1980s and 1990s, and policy responses to these changes.

# Chapter 2: Methods

## 2.1 Data

The New Zealand Census – Mortality Study (NZCMS) anonymously and probabilistically links census and mortality data to form four census–cohort studies of the entire New Zealand population, each followed up for three years of mortality. The census cohorts are 1981–84, 1986–89, 1991–94 and 1996–99. The record linkage methodology and structure of the NZCMS data are described in detail elsewhere (Blakely 2002b; Blakely et al 2000; Fawcett et al 2000; Blakely and Salmond 2002; Hill et al 2002). A brief overview is provided here.

### 2.1.1 Record linkage

Mortality records were assembled for decedents aged 0–74 years on the previous census night, who died within three years of the 1981, 1986, 1991 or 1996 census. Non-New Zealand residents were excluded, resulting in 44,932, 44,821, 41,915 and 39,665 mortality records, respectively. Automatch® software was used to anonymously and probabilistically link the census and mortality data (Jaro 1995; MatchWare Technologies 1998). Record linkage was conducted by staff of Statistics New Zealand under strict confidentiality criteria. The matching variables were sex, ethnic group, date of birth, country of birth and geocode. The geocode was the most discriminatory matching variable, being meshblock codes (approximately 100 individuals live in each meshblock) or area unit codes (approximately 2000 people). If people had moved 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, 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).

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 record were representative of the 40 decedents. This weighting process was undertaken for hundreds of strata, meaning that there was unlikely to be any residual linkage bias. All analyses presented in this report use these weights.

### 2.1.2 Cohorts

The cohorts included in the analyses in this report were New Zealand-resident, census respondents aged 25–74 years on census night. People aged 72, 73 and 74 years on census night were retained in the study at ages 75, 76 and 77 years during out-years of follow-up. In epidemiological terms, the cohort consisted of person-time for 25–77-year-olds. The NZCMS does not link mortality records for people aged 75 years and older on census night. However, we thought it best for both comprehensiveness and study power to include all available person-time, hence the 25–77 years age range.

People with missing household income, highest educational qualification or occupational class were excluded from the respective analyses. The person-years of follow-up for each cohort included in the study were between 4.7 and 6.2 million (Table 2). The actual number of people contributing this person time was approximately a third of the person-years.

**Table 2:** Person-years of follow-up

| Exclusion | 1981–84 | 1986–89 | 1991–94 | 1996–99 |
|---|---|---|---|---|
| 1. Full cohort with sex, age or ethnic group | 4,765,849 | 5,197,536 | 5,583,000 | 6,169,769 |
| 2. Excluding missing education | 4,274,102 | 4,821,245 | 5,455,622 | 5,867,222 |
| 3. Excluding missing household income | 3,818,590 | 4,365,357 | 4,711,842 | 5,000,449 |

### 2.1.3 Equivalised household income

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.

Household income more fully reflects the resources available to the individual than personal income and so household income is a more appropriate measure for the analysis of health inequalities. However, households of different size and composition require different incomes to produce similar standards of living. There are economies of scales 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.

Household equivalised income was calculated in the following way. First each individual was assigned the median income for their income category. The values for the median household income were obtained from the corresponding New Zealand Household Economic Survey for the latter three censuses and set as the mid-point of the income category (and Pareto estimate for top category) for the 1981 census. The personal income of all household members was 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 (Table 3) (Jensen 1988: 33–4). 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 income on the 1981, 1986 and 1991 census cohort data was further adjusted for spending parity to 1996 dollars, using the Consumer Price Index (CPI).

**Table 3:** The revised Jensen Index

| Number of adults | Number of children | | | | | | |
|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | 0.65 | 0.91 | 1.14 | 1.34 | 1.52 | 1.69 | 1.85 |
| 2 | 1.00 | 1.21 | 1.41 | 1.58 | 1.75 | 1.91 | 2.06 |
| 3 | 1.29 | 1.47 | 1.65 | 1.81 | 1.96 | 2.11 | 2.25 |
| 4 | 1.54 | 1.71 | 1.87 | 2.02 | 2.16 | 2.30 | 2.44 |

For the majority of analyses in this report, three categories of equivalised household income were used: low (< $26,109, CPI adjusted to 1996 and equivalised as above), medium ($26,109 to $43,015) and high (≥ $43,016).

Quintile categories of income were used to calculate the slope and relative indices of income, with quintile categories specific to each census by sex and age group (described in detail below).

Given that a valid household income requires that all adults in the household were both at home on census night *and* actually volunteered a personal income, household income is prone to being 'missing'. The percentage of 25–74-year-old census respondents without a valid household income variable ranged from 15% to 20% across the four cohorts. If the association of income and mortality were markedly different among these respondents, then analyses based on the 80% to 85% with valid data may be prone to selection bias. Extensive sensitivity analyses published elsewhere (Jackie Fawcett, PhD in progress, and Blakely 2002b) suggest that any important selection bias is unlikely.

### 2.1.4 Highest educational qualification

The highest educational qualification was the highest qualification gained since leaving school or, where the respondent had no post-school qualifications, the highest school qualification. Two problems needed to be addressed in the categorisation of the education variable. First, the census instruments for collecting and categorising the educational qualifications were different for each census. Second, maintaining a hierarchy of qualifications from high to low was problematic because the position of some qualifications relative to others is not always clear. In particular, determining whether a post-school non-university degree qualification should be ranked higher than a higher school qualification was not always straightforward.

In order to ensure that the categorisation of education across the four cohorts was as comparable as possible, an inter-censal classification of education, developed by Statistics New Zealand, was used. This classification was further grouped into five- and three-level groupings to obtain categories of sufficient size for robust analyses (Table 4 below). The decision about grouping qualifications into five and three groups was based on the ideal of maintaining a hierarchy of qualifications from low (none) to high (university degree) while at the same time maintaining consistency across the four cohorts.

**Table 4:** Five- and three-level groupings of highest educational qualification

| Five-level education grouping | | Three-level education grouping | |
|---|---|---|---|
| **Description** | **Label** | **Description** | **Label** |
| No qualifications | No qualifications | No qualifications | Low |
| 5th form school qualification<br>6th/7th form school qualification | School – low<br>School – high | Any school qualification | Medium |
| Trade and other post-school<br>University degree, nursing or teaching diploma or NZCS or technician's certificate | Post-school – low<br>Post-school – high | Any post-school qualification | High |

### 2.1.5 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 (ie, the 1968 version; all four cohorts), NZSCO90 (1991 and 1996 cohorts) and NZSCO95 (1996 cohort). Occupational class classifications are available for each of these occupational classifications (Elley and Irving 1976; Davis et al 1999; Davis et al 2004). To ensure maximum comparability of the class classification across the four cohorts, we used the NZSCO68 linked Elley–Irving Classification. Farmers were, however, coded to a separate class, because of their ambiguous social class position.

### 2.1.6 Ethnicity

Ethnicity was not the major focus of this report. However, given that there are large differences in mortality by ethnicity in New Zealand – and that ethnicity is a major predictor of income, educational qualifications or occupational class – ethnicity is likely to confound the association of income, education or occupation with mortality. Therefore, all calculations in this report adjust for ethnicity (in addition to age).

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 census 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.

### 2.1.7 Causes of death

In addition to all causes of death combined, we present results for the causes of death listed in Table 5. Cause of death was coded according to the ICD9 classification throughout the entire 1981–99 period. Time trends in mortality by cause of death will therefore be unaffected by changes in the classification method. In theory, changes in practice with regard to the recording of causes on the death certificate could still affect trends for some causes. However, as we used only relatively wide classifications of cause of death, we do not anticipate that any changes in the recording of cause of death will affect these analyses. Two possible exceptions are for avoidable mortality, which is based on many finer-grained ICD groupings, and diabetes, which is prone to under-reporting as the underlying cause of death.

**Table 5:** ICD codes

| Cause of death | ICD9 codes |
|---|---|
| Avoidable mortality | See separate table |
| Cardiovascular disease:<br>IHD<br>Cerebrovascular | 410–414, 393–409, 415–459<br>410–414<br>430–438 |
| Diabetes | 250 |
| Cancer:<br>Colorectal<br>Lung<br>Breast<br>Prostate | 140–209<br>153–154<br>162<br>174<br>185 |
| Chronic lung disease | 470–478, 490–519 |
| Unintentional injury:<br>Road traffic crash (RTC)<br>Non-RTC | 800–949<br>810–825<br>800–809, 826–949 |
| Suicide | 950–959, 980–989 |

### 2.1.8 Avoidable and amenable mortality

Deaths were also classified as 'potentially avoidable' or 'unavoidable' by categorial attribution. A potentially avoidable death is defined as one that could theoretically have been avoided, through prevention or treatment, given current understanding of causation and currently available disease prevention and health care technologies.

Categorial attribution of causes of death as either avoidable or non-avoidable was first proposed by Rutstein et al 1976, and the first widely used list of causes of avoidable mortality was assembled by Charlton et al 1983. Charlton et al's list has been updated on several occasions to reflect developments in prevention and treatment technology (Albert et al 1996; Simonato et al 1998; Nolte and McKee 2003; Tobias and Jackson 2001). The categorisation used in this report is based on a further recent update of this list (Tobias and Glover unpublished; Table 6).

**Table 6:** List of avoidable (including amenable) causes of death (ages 25–74 years)

| Condition | ICD-09 | Amenable |
|---|---|---|
| Tuberculosis | 010–018,137 | Yes |
| Selected invasive bacterial and protozoal infection | 034–036, 038, 084, 320, 481–482, 485, 681–682 | Yes |
| HIV/AIDS | 042 | |
| Hepatitis | 070 | |
| Viral pneumonia and Influenza | 480, 487 | |
| Lip, oral cavity and pharynx cancers | 140–149 | |
| Oesophageal cancer | 150 | |
| Stomach cancer | 151 | |
| Colorectal cancer | 153, 154 | Yes |
| Liver cancer | 155 | |
| Lung cancer | 162 | |
| Melanoma of skin | 172 | Yes |
| Non-melanotic skin cancer | 173 | Yes |
| Breast cancer | 174 | Yes, females |
| Uterine cancer | 179, 182 | Yes |
| Cervical cancer | 180 | Yes |
| Bladder cancer | 188 | Yes |
| Thyroid cancer | 193 | Yes |
| Hodgkins disease | 201 | Yes |
| Leukaemia | 204–208 | Yes, < 45 years |
| Benign tumours | 210–229 | Yes |
| Thyroid disorders | 240–246 | Yes |
| Diabetes | 250 | Yes, 50%* |
| Alcohol-related disease | 291, 303, 305.0, 425.5, 535.3, 571.0–571.3, 760.8 | |
| Illicit drug use disorders | 292, 304, 305.2–305.9 | |
| Epilepsy | 345 | Yes |
| Rheumatic and other valvular heart disease | 390–398 | Yes |
| Hypertensive heart disease | 402 | Yes |
| Ischaemic heart disease | 410–414 | Yes, 50% * |
| Cerebrovascular diseases | 430–438 | Yes, 50% * |
| Aortic aneurysm | 441 | |
| Nephritis and nephrosis | 403, 580–589, 591 | Yes |
| Obstructive uropathy and prostatic hyperplasia | 592, 593.7, 594, 598, 599.6, 600 | Yes |
| Deep vein thrombosis with pulmonary embolism | 415.1, 451.1 | |
| Chronic obstructive pulmonary disease | 490–492, 496 | Yes, ≥ 45 years |
| Asthma | 493 | Yes, < 45 years |

| Condition | ICD-09 | Amenable |
|---|---|---|
| Peptic ulcer disease | 531–534 | Yes |
| Acute abdomen, appendicitis, intestinal obstruction, cholecystitis/ lithiasis, pancreatitis, hernia | 540–543, 550–553, 574–577 | Yes |
| Chronic liver disease | 571.4–571.9 | |
| Birth defect | 740–759 | Yes |
| Complications of perinatal period | 764–779 | Yes |
| Road traffic injuries, other transport injuries | E810–E819 | |
| Accidental poisonings | E850–E869 | |
| Falls | E880–E886, E888 | |
| Fires, burns | E890–E899 | |
| Drownings | E910 | |
| Suicide and self-inflicted injuries | E950–E959, E980–E989 | |
| Violence | E960–E969 | |

* Fifty percent of deaths randomly assigned as amenable.

Approximately 80% of deaths in the 25–74 years age group were classified as avoidable using the updated list. Note that only deaths occurring before age 75 years are categorised as avoidable or not. The avoidable categorisation is not used after 75 years because the high prevalence of co-morbidity experienced by older people causes difficulties in attributing death to a single cause.

It is important to note that the analyses in this report cover two decades, and the same categorisation of avoidable and amenable mortality was used in each period. We considered using different lists of avoidable and amenable diseases for each period to reflect developments in prevention and treatment technology. However, due to the difficulty of specifying the appropriate changes and the lack of comparability that such an expanding list over time would create, we decided to use the same classification for each period. This means that changes in prevention and treatment during the 1980s and 1990s are not taken into account, possibly biasing the estimates of trends in inequalities in avoidable mortality.

Included in the list of avoidable causes is a subset of causes designated *amenable* (last column of Table 6). Amenable causes are those that, with current medical treatment, should not result in death. That is, even where the disease is not prevented, the case fatality of the disease can still be minimised through personal health care. Unlike avoidable mortality, amenable mortality includes a number of ICD codes from which only a proportion (50%) of deaths are randomly selected for inclusion. In particular, 50% of deaths from IHD, cerebrovascular disease and diabetes, are designated as *amenable,* to reflect the limited efficacy of treatment for these conditions (as opposed to prevention). Just as the categorisation of avoidable deaths will change over time, so too will the categorisation of amenable deaths. (As with avoidable death, we used the same categorisation of amenable death for each of the four cohorts.) It is also important to note that the assumption of a constant proportion of 50% amenable deaths within these ICD codes *across* socioeconomic groups at any one point in time may be a possible source of bias. That is, the proportion of deaths amenable to treatment may vary by socioeconomic position. Accordingly, analyses of levels and trends in socioeconomic inequalities in amenable causes of death should be treated with caution.

## 2.2 Direct standardisation

To enable comparison of rates between income, occupation and education groups with different age structures and ethnic compositions, mortality rates have been directly age- and ethnic-standardised using the 1991 cohort as the reference population. This standardisation means that comparisons between socioeconomic groups, and over time, are not confounded by variations in the age and ethnic composition of the groups (Rothman and Greenland 1998).

Age- and ethnicity-standardised rates (per 100,000), standardised rate ratios (SRRs) and standardised rate differences (SRDs) are presented in this report. The report makes extensive use of graphical presentations of the standardised rates. The actual standardised rates, rate ratios and rate differences are presented in tables in the Appendix, available in the web-based version (www.moh.govt/phi or www.wnmeds.ac.nz/nzcms-info.html).

## 2.3 Measures of association or effect

The SRRs and SRDs are two measures of the strength of the association of income (or education or occupation) with mortality. The former measures the *relative* inequality as a (unit-less) ratio, and the latter measures the *absolute* difference (per 100,000) of the rates.

The SRRs and SRDs are calculated for low and medium income, occupation or educational groups compared to the reference high income, occupation or educational groups, respectively. Ninety-five percent confidence intervals are presented in the figures and tables.

## 2.4 Relative and slope indices of inequality

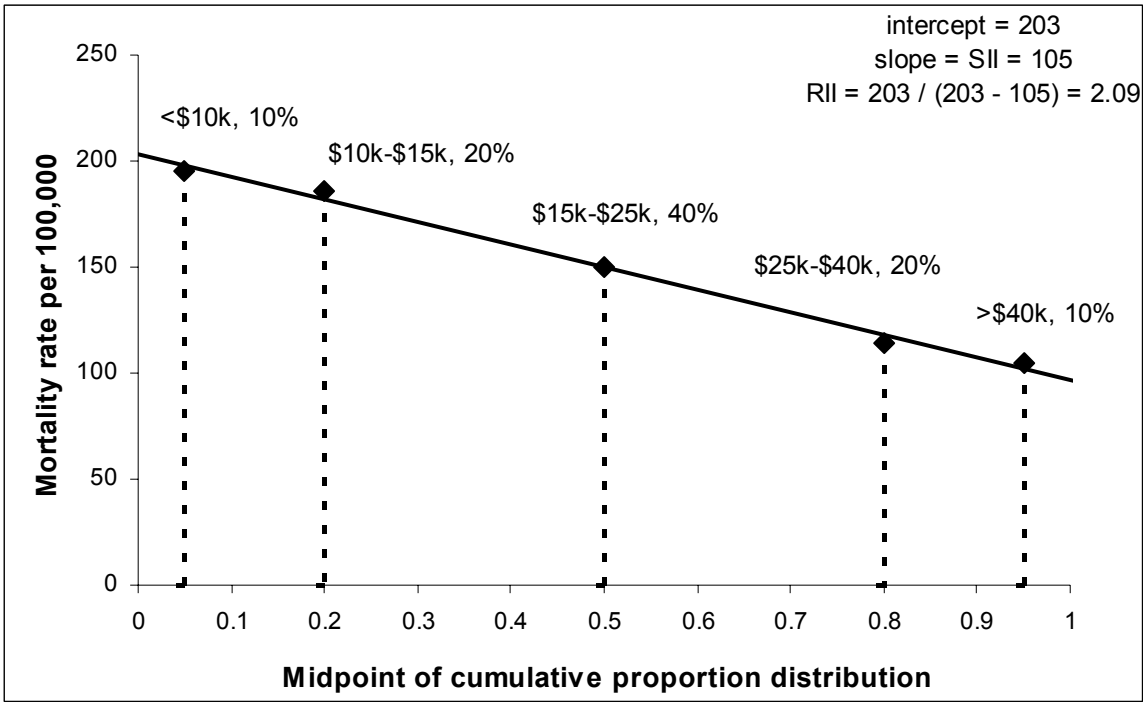
The relative index of inequality (RII) and slope index of inequality (SII) are more sophisticated *relative* and *absolute* measures, respectively (Mackenbach and Kunst 1997; Pamuk 1985; Hayes and Berry 2002). They were introduced in conceptual terms in section 1.6 of this report. In this section we focus on the methodological and interpretative issues. Figure 2 below demonstrates briefly how the RII and SII are calculated (using data in Table 7), and how the RII and SII vary with a different income distribution despite no difference in the mortality rates for each income group.

**Table 7:** Hypothetical standardised mortality rates, by income category, proportion of people in each income category for two scenarios, and accompanying SRD, SRR, SII and RII

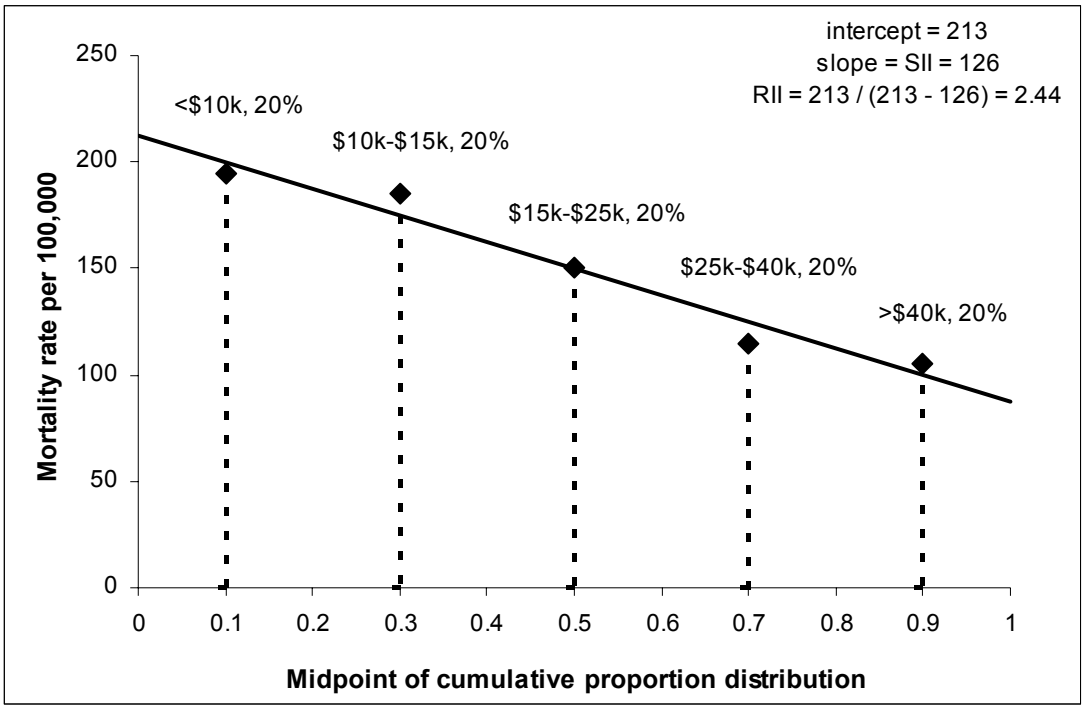
| Income group | Mortality rate per 100,000 | Scenario 1: Narrow income distribution Figure 2(a) | | Scenario 2: Wide income distribution Figure 2(b) | |
|---|---|---|---|---|---|
| | | Percentage of population | Midpoint on cumulative proportion distribution | Percentage of population | Midpoint on cumulative proportion distribution |
| < $10,000 | 195 | 10 | 0.95 | 20 | 0.9 |
| $10,000–$15,000 | 186 | 20 | 0.8 | 20 | 0.7 |
| $15,000–$25,000 | 150 | 40 | 0.5 | 20 | 0.5 |
| $25,000–$40,000 | 115 | 20 | 0.2 | 20 | 0.3 |
| > $40,000 | 105 | 10 | 0.05 | 20 | 0.1 |
| **Measure of association** | | | | | |
| SRD | | 90 per 100,000 | | 90 per 100,000 | |
| SRR | | 1.86 | | 1.86 | |
| SII | | 106 per 100,000 | | 126 per 100,000 | |
| RII | | 2.09 | | 2.44 | |

**Figure 2:** Mortality rates plotted by cumulative proportion distribution

(a): Scenario 1: Narrow income distribution



(b): Scenario 2: Wide income distribution




Notes: Labels are income value and percentage of population in each category; trend-line is from ordinary least squares regression (unweighted); the intercept and slope, and derived SII and RII, are shown in the top right corner of each figure.

Consider Scenario 1 first, where 10%, 20%, 40%, 20% and 10% of the population are in each income group, from low to high, respectively. To determine the SII and RII, it is useful to construct a figure with each income group's mortality rate plotted on the y-axis, with the mid-point of each income group's cumulative proportion of the population plotted on the x-axis (Figure 2(a)). As the lowest income group (< $10,000) comprises 10% of the population in Scenario 1, its mortality rate of 195 per 100,000 is plotted at 0.05 on the x-axis. The next income group's x-axis value is $0.1 + (0.5 \times 0.2) = 0.2$, and so on.

Having plotted these x–y points, the regression-based slope and intercept can be calculated. In Scenario 1, the slope is -105 and the intercept is 203. The RII is then 203/[203 – 105] = 2.09. That is, the poorest person has an expected mortality risk that is 2.09 times that expected of the richest person, somewhat more than the SRR of 1.86 (ie, 195/105). The reason the RII is greater can be seen visually in Figure 2(a): the RII is based on the expected mortality rates for the poorest and richest *persons* in the population, not the mortality rates for the midpoints of the lowest and highest income *categories*. The SII is simply the slope of 105 per 100,000. That is, the poorest person has an expected mortality rate of 105 per 100,000 greater than that expected for the richest person.

### 2.4.1 How can a different income distribution change the SII and RII, but leave the SRD and SRR unchanged?

Scenario 2 above (Table 7 and Figure 2(b)) portrays the same five income groups (using the same dollar cut-points) as Scenario 1, the same mortality rates for each income group, but different proportions of the population in each income group. The income distribution in Scenario 2 is wider than that in Scenario 1 as a greater proportion of the population are in the lowest and highest income groups. As a consequence, the scatter plot behind the calculation of the SII and RII (Figure 2(b)) has the plot points for the highest and lowest income groups each shifted towards the middle slightly, allowing the regression line more 'x-axis space' to achieve a higher intercept and steeper slope. Accordingly, the SII of 126 per 100,000 is greater than 105 per 100,000 in Scenario 1, and the RII of 2.44 is greater than 2.09 in Scenario 1. However, *the SRD and SRR are unchanged*.

The key point for this report is that because we have specified the SRD and SRR to compare mortality rates for income categories with fixed dollar cut-points (inflation adjusted) over time, a widening income distribution over time (as was the case in New Zealand during the 1980s and 1990s) will cause the SII and RII to increase even if there was no change in the SRD and SRR. By extension, if either the SRD or SRR increase over time, the SII or RII will increase more in times of widening income distributions.

RIIs and SIIs are measures of impact that capture *both* the strength of the association with mortality risk per unit of the socioeconomic factor (eg, per dollar of income) *and* the distribution of the socioeconomic factor (eg, income) over the population.

### 2.4.2 How the SIIs and RIIs were calculated in this report

In this report, RIIs and SIIs were calculated using weighted linear regression of the age- and ethnicity-standardised mortality rates for quintile groupings of income, and for the five education groups based on highest attained educational qualification. The weights were the person-time in each income quintile or category of education. The calculation of the x-values (or mid-points for each category on the cumulative proportion distribution) were done *separately* for each sub-population to which RIIs and SIIs were being calculated. For example, the same real adjusted household income for 25–44 and 60–77-year-olds may receive a different relative position on the cumulative proportion scale.

## 2.5 Life expectancy

The life-table is a useful way of summarising a set of age-specific mortality rates. It allows us to calculate parameters such as life expectancy at birth, local life expectancy between any two ages, the probability of surviving to exact age $x$ (having survived to exact age $y$), and age- and cause-deleted life expectancies. It is important to note, however, that the life-table is not just a simple transformation of mortality rates. As a form of survival analysis, it counts the living rather than the dead. Variations in life expectancy at birth, for example, are not simply a mirror image of patterns in age-standardised mortality rates.

Abridged life-tables (ie, five-year age groups) were constructed for each income group (using the three-group classification: high, medium and low, and 'missing income') for each period using conventional demographic methods. For age groups not included in the NZCMS data set (ie, infants and 80 years and older) national mortality rates were used (ie, it was assumed that mortality did not vary with income).

We first calculated the *life expectancy* at birth (LEo) of each income group. In order to remove confounding by ethnicity, we then calculated *ethnically weighted* life expectancy. This weighting held constant the proportions of Māori and non-Māori at birth (ie, for the radix) for each synthetic cohort used in the life-table calculations, using the 1991 population distribution by ethnicity as the weighting.

We then calculated the *probability of surviving* the different life-cycle stages, up to exact age 75. We do not go beyond age 75 here as the underlying NZCMS data extend only to this age. By examining differences in the survival probabilities, we can see which age groups contribute most to the gradients in survival by income.

Finally, we calculated *cause-deleted life expectancies*. Cause-deleted life expectancies enable the estimation of the contribution of a particular cause of death to the overall gradient in life expectancy by income. Specifically, we compare the life expectancy from exact age 1 to exact age 75 calculated in the usual way, with the same parameter calculated from a set of mortality rates from which we have removed all deaths caused by the disease of interest. The difference between these two life expectancies is a measure of the burden of the cause of interest.

## 2.6 Excess deaths and potential years of life lost

Excess deaths were calculated as the number of deaths that would have been avoided had both the medium- and low-income groups (using the three-level category, with fixed dollar cut-points over time) had the same mortality rates as the high-income group. The calculations were based on the mortality rates and census counts for each of the four cohorts. Given the growth in the New Zealand population over time, therefore, the excess deaths would increase over the four cohorts even had the mortality rates remained constant.

Potential years of life lost (PYLL) weight deaths by the age at death, and so provide a measure of the *prematurity* of mortality. This may be a more policy-relevant measure than death counts themselves. PYLL were calculated for each category of interest using the remaining life expectancy method, with UN model life-table West Level 26 as the standard for both males and females. The mortality rates used were ethnicity-standardised for each five-year age group. Years of life lost were discounted to net present value using a discount rate of 3% as recommended by WHO (Murray and Lopez 1996), and presented as rates per 100,000 standardised to the 1991 New Zealand age distribution.

## 2.7 Analyses

Primary analyses on unit record NZCMS data were conducted in the Data Laboratory of Statistics New Zealand, and secondary analyses at the Wellington School of Medicine and Health Sciences and Public Health Intelligence, Ministry of Health. All analyses were conducted in SAS. In addition to 95% confidence intervals, other tests of statistical significance were also conducted. First, we tested for linear trends in rates, SRDs, SRRs, SIIs and RIIs. Because SRRs and RIIs are ratio measures, we tested for linear trends of the log-transformations of these variables.

The box below provides a brief guide to interpreting trends in the four measures of inequality used in this report – the SRD, SRR, SII and RII.

### Guide to understanding trends in SRDs, SRRs, SIIs, and RIIs

Understanding the inter-relationships of the four main measures of association used in this report is key to interpreting the report's findings.

The *background secular trends in mortality* determine whether both absolute measures of inequality (ie, SRD and SII) and relative measures of inequality (ie, SRR and RII) can trend in the same direction. The table below summarises the possible changes in relative and absolute inequality measures when different backgrounds trends in overall mortality are operating. As overall mortality declined during the 1980s and 1990s in New Zealand for most causes of death, the first column (decreasing overall mortality) is the most relevant for this report. However, overall cancer mortality changed little (middle column) and suicide mortality increased among young adults (third column) over this period.

**Table B1:** Inter-relationships of absolute with relative (SRD with SRR, or SII with RII) measures of the income–mortality association, in the face of background secular trends in overall mortality rates

| Association of mortality with income in absolute terms | Background secular trend in mortality rates | | |
|---|---|---|---|
| | Decreasing | No change | Increasing |
| SRD ↓ | ? | ↓ SRR | ↓↓ SRR |
| No change in SRD | ↑ SRR | No change in SRR | ↓ SRR |
| SRD ↑ | ↑↑ SRR | ↑ SRR | ? |
| SII ↓ | ? | ↓ RII | ↓↓ RII |
| No change in SII | ↑ RII | No change in RII | ↓ RII |
| SII ↑ | ↑↑ RII | ↑ RII | ? |

Trends in the RII and SII are influenced by both the level of mortality in each income group and the distribution of the population across income groups (see section 2.4, page 18). The table below illustrates the influence on the RII and SII of changes in the income distribution over time. Because the income distribution widened in New Zealand during the 1980s and 1990s, the third column is most relevant to this report.

**Table B2:** Inter-relationships of absolute (SRD with SII) and relative (SRR with RII) measures of the income–mortality association, for variations in income distribution and strength of the income–mortality association over time

| Association of mortality with each dollar of income (CPI adjusted) | Income distribution over time | | |
|---|---|---|---|
| | Narrows | Stays the same | Widens |
| **Absolute terms** | | | |
| SRD ↓ | ↓↓ SII | ↓ SII | ? |
| No change in SRD | ↓ SII | No change in SII | ↑ SII |
| SRD ↑ | ? | ↑ SII | ↑↑ SII |
| **Relative terms** | | | |
| SRR ↓ | ↓↓ RII | ↓ RII | ? |
| No change in SRR | ↓ RII | No change in RII | ↑ RII |
| SRR ↑ | ? | ↑ RII | ↑↑ RII |

Notes: SRD = standardised rate difference; SRR = standardised rate ratio; SII = slope index of inequality; RII = relative index of inequality.

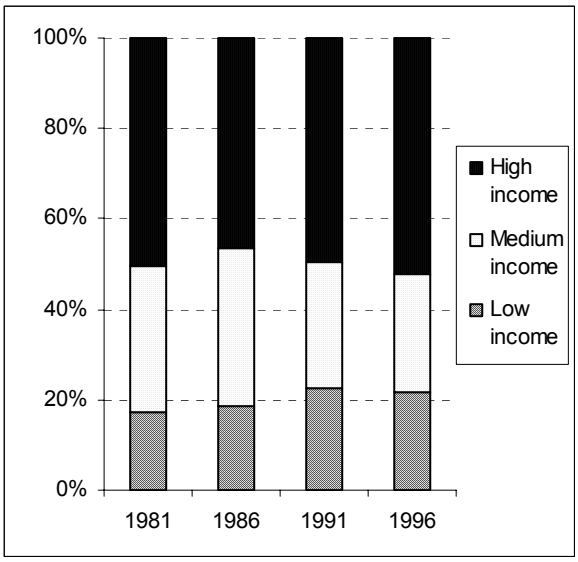
# Chapter 3: Income Trends

Before considering mortality by income, it is important first to understand trends in income level and distribution over the 1980s and 1990s. In common with many countries, the distribution of incomes in New Zealand widened over this period – although the changes in New Zealand were particularly marked. From the late 1980s to early 1990s, income inequality as measured by the Gini coefficient jumped notably (Statistics New Zealand 1999), and since then has continued to increase more slowly.

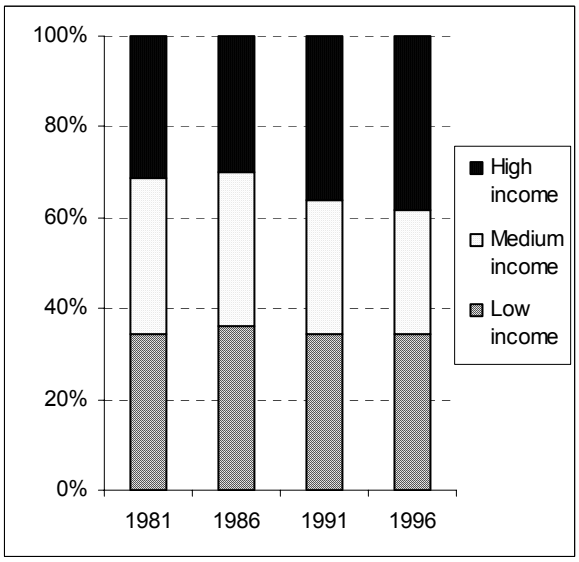
Figure 3 below shows the percentage of people in each of the three income groups for each of the four census–mortality cohorts in the NZCMS, for (a) 45–59-year-old males and (b) 25–44-year-old females. It is evident that the size of the middle-income group shrinks over time for both examples, while the percentage in the high- and low-income groups increases (the latter less so for females). That is, the spread of incomes increases over time. The actual percentages are shown in Table 8 for all age groups.

**Figure 3:** Percentage of people in each income group in each cohort

(a) Males, 45 to 59 years




(b) Females, 25 to 44 years




This widening income distribution over time has an important consequence for the results in this report. As discussed earlier (page 18), the RII and SII are affected by both the income distribution and the mortality rate at each level of income. Even if mortality rates remained constant at each level of income, the relative increase in the proportion of each cohort having incomes towards the extremes of the income distribution will in itself cause an increase in the RII and SII.

**Table 8:** Person-years in each income category over time by age, and percentage distribution by income for those with a non-missing income

| Age group | Income | 1981 | | 1986 | | 1991 | | 1996 | |
|---|---|---|---|---|---|---|---|---|---|
| **Males** | | | | | | | | | |
| 25–77 years | Low | 529,419 | 28% | 631,010 | 29% | 725,338 | 31% | 744,206 | 30% |
| | Medium | 595,066 | 31% | 734,069 | 34% | 652,393 | 28% | 658,421 | 27% |
| | High | 735,501 | 39% | 766,208 | 35% | 912,531 | 39% | 1,025,330 | 42% |
| | Missing | 488,302 | | 427,677 | | 447,212 | | 586,886 | |
| 25–44 years | Low | 264,939 | 28% | 321,766 | 29% | 326,175 | 28% | 333,028 | 27% |
| | Medium | 329,433 | 34% | 375,498 | 34% | 353,410 | 30% | 345,429 | 28% |
| | High | 351,095 | 37% | 387,639 | 35% | 478,284 | 41% | 524,012 | 43% |
| | Missing | 235,309 | | 239,053 | | 254,464 | | 302,985 | |
| 45–59 years | Low | 91,936 | 17% | 107,872 | 18% | 143,650 | 22% | 159,690 | 21% |
| | Medium | 172,529 | 32% | 206,366 | 35% | 179,089 | 27% | 193,730 | 26% |
| | High | 268,160 | 50% | 270,525 | 46% | 317,232 | 49% | 383,758 | 52% |
| | Missing | 148,343 | | 122,474 | | 124,171 | | 178,028 | |
| 60–77 years | Low | 172,544 | 45% | 201,372 | 43% | 255,514 | 51% | 251,488 | 51% |
| | Medium | 93,105 | 24% | 152,204 | 32% | 119,894 | 24% | 119,262 | 24% |
| | High | 116,246 | 30% | 108,044 | 23% | 117,015 | 23% | 117,560 | 24% |
| | Missing | 104,651 | | 66,150 | | 68,578 | | 105,873 | |
| **Females** | | | | | | | | | |
| 25–77 years | Low | 708,202 | 36% | 816,931 | 36% | 927,769 | 38% | 948,258 | 36% |
| | Medium | 598,979 | 30% | 745,288 | 33% | 658,698 | 27% | 671,194 | 26% |
| | High | 651,422 | 33% | 671,852 | 30% | 835,113 | 34% | 953,039 | 37% |
| | Missing | 458,957 | | 404,501 | | 423,946 | | 582,434 | |
| 25–44 years | Low | 334,900 | 34% | 398,374 | 35% | 419,353 | 34% | 445,561 | 34% |
| | Medium | 337,743 | 34% | 377,453 | 34% | 356,398 | 29% | 348,131 | 26% |
| | High | 305,040 | 31% | 332,585 | 30% | 437,986 | 36% | 496,816 | 38% |
| | Missing | 204,910 | | 227,778 | | 244,197 | | 298,044 | |
| 45–59 years | Low | 121,710 | 23% | 135,482 | 23% | 177,532 | 27% | 187,968 | 25% |
| | Medium | 157,802 | 30% | 201,263 | 34% | 175,525 | 27% | 193,803 | 26% |
| | High | 242,709 | 46% | 246,954 | 42% | 295,488 | 45% | 362,824 | 48% |
| | Missing | 138,749 | | 111,435 | | 115,241 | | 178,161 | |
| 60–77 years | Low | 251,592 | 54% | 283,075 | 52% | 330,883 | 59% | 314,729 | 58% |
| | Medium | 103,434 | 22% | 166,573 | 30% | 126,776 | 22% | 129,261 | 24% |
| | High | 103,673 | 22% | 92,314 | 17% | 101,640 | 18% | 93,399 | 17% |
| | Missing | 115,297 | | 65,288 | | 64,508 | | 106,229 | |

Note: Percentages are column (or within-year) percentages, and only apply to people with an income value.

To aid interpretation of the results in this report, it is useful to understand how the composition of each of the three income groups varied over the 1980s and 1990s, especially in relation to ethnic mix, educational qualifications and employment status (Table 9). As would be expected, the percentages of people employed and unemployed varied markedly across income categories. Of note, the percentage of males employed among the low-income group dropped notably from the 1986 census (61.5%) to the 1991 census (42.5%) and recovered somewhat by the 1996 census (47.8%). The percentage of employed females in each income group increased over time, but the increase was more notable in the high-income group. The percentage unemployed in each income category mirrored the percentage employed, with a large jump from 4.3% to 11.5% among low-income males between 1986–89 and 1991–94.

The low-income group consistently had a higher percentage of people with nil qualifications than the high-income group. The percentages with nil qualifications reduced over time in each income category by roughly similar amounts, consistent with the background cohort changes in educational level. The percentage of people with post-school qualifications tended to mirror those for nil qualifications.

By ethnicity, non-Māori non-Pacific people consistently comprised a greater percentage of the high-income category than of the low-income category. Nevertheless, non-Māori non-Pacific people consistently made up more than 80% of the low-income group. The percentages of both Māori and Pacific people were consistently greater in the low-income category. Of note, the percentage of Pacific people in the low-income category peaked in 1991. However, this must be interpreted cautiously because of changing ethnic definitions between the 1991 and 1996 census. (We use the prioritised definition of ethnicity in Table 9.)

**Table 9:** Percentage of people in each income category by ethnicity and socioeconomic characteristics, ages 25–74 years combined

| Variable | Income group | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1981 | 1986 | 1991 | 1996 | 1981 | 1986 | 1991 | 1996 |
| Employed (full and part-time) | Low income | 62.4 | 61.5 | 42.5 | 47.8 | 24.1 | 29.1 | 25.7 | 32.1 |
| | Medium income | 88.9 | 83.2 | 77.7 | 79.6 | 51.4 | 56.8 | 58.8 | 62.9 |
| | High income | 94.1 | 92.9 | 90.0 | 92.0 | 69.1 | 76.5 | 77.8 | 81.6 |
| Unemployed | Low income | 4.1 | 4.3 | 11.5 | 8.9 | 1.2 | 5.1 | 6.3 | 6.2 |
| | Medium income | 1.1 | 1.5 | 4.4 | 2.8 | 0.8 | 3.0 | 3.4 | 2.9 |
| | High income | 0.6 | 0.7 | 1.9 | 1.1 | 0.6 | 1.3 | 1.8 | 1.4 |
| Nil qualifications | Low income | 61.4 | 45.1 | 43.8 | 44.4 | 65.0 | 51.8 | 47.3 | 46.4 |
| | Medium income | 49.0 | 37.8 | 34.0 | 34.3 | 55.3 | 45.8 | 37.1 | 34.9 |
| | High income | 39.7 | 25.9 | 21.5 | 21.6 | 45.1 | 32.5 | 24.3 | 21.8 |
| Post-school qualification | Low income | 18.6 | 31.9 | 34.8 | 31.9 | 11.6 | 18.4 | 22.8 | 23.1 |
| | Medium income | 28.4 | 41.0 | 45.5 | 40.3 | 18.3 | 25.8 | 33.6 | 31.6 |
| | High income | 36.6 | 52.7 | 57.9 | 52.7 | 28.1 | 40.2 | 48.7 | 45.5 |
| Māori | Low income | 10.7 | 10.4 | 12.6 | 13.3 | 10.0 | 10.2 | 12.9 | 14.0 |
| | Medium income | 7.4 | 8.1 | 8.7 | 10.6 | 7.0 | 7.7 | 8.3 | 10.1 |
| | High income | 4.4 | 4.8 | 4.9 | 6.8 | 4.4 | 4.7 | 4.7 | 6.5 |
| Pacific | Low income | 3.1 | 3.5 | 4.6 | 4.1 | 2.5 | 3.0 | 4.2 | 3.9 |
| | Medium income | 2.2 | 2.5 | 2.9 | 3.3 | 2.1 | 2.4 | 2.9 | 3.4 |
| | High income | 1.1 | 1.2 | 1.3 | 1.8 | 1.1 | 1.3 | 1.4 | 1.9 |
| Non-Māori Non-Pacific | Low income | 86.2 | 86.1 | 82.8 | 82.6 | 87.5 | 86.8 | 82.9 | 82.1 |
| | Medium income | 90.5 | 89.5 | 88.4 | 86.0 | 90.9 | 89.9 | 88.8 | 86.6 |
| | High income | 94.6 | 94.0 | 93.7 | 91.3 | 94.5 | 94.0 | 93.9 | 91.5 |

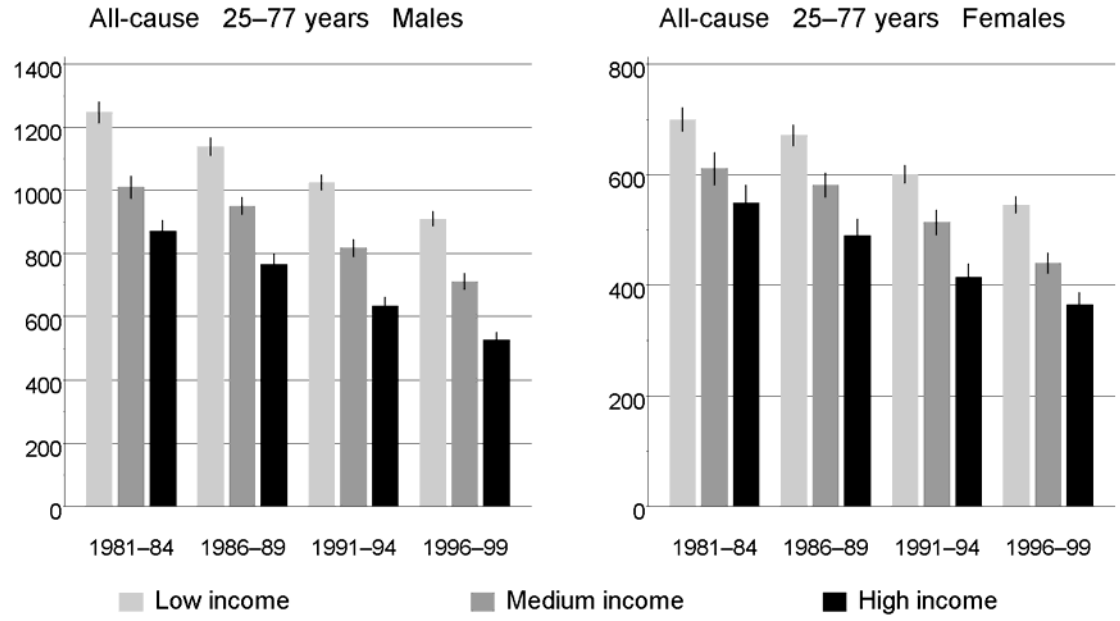
# Chapter 4: All-cause Mortality

For guidance on the inequality measures used, see 'Guide to understanding trends in SRDs, SRRs, SIIs, and RIIs' (page 23).

## 4.1 Age-standardised rates (25–77 years)

In all four cohorts, all-cause mortality rates were consistently higher for people with low income. However, mortality rates declined over time within all three levels of income (Figure 4). Among males, mortality rates declined by 39% (or 344 per 100,000) from 1981–84 to 1996–99 in the high-income group and by 27% (or 338 per 100,000) in the low-income group. Among females, mortality rates declined by 34% (or 185 per 100,000) in the high-income group and by 22% (or 155 per 100,000) in the low-income group.

**Figure 4:** All-cause mortality rates, ages 25–77 years, by income and sex




Notes:

- Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 46.
- Different scales for male and female charts.

In absolute terms, the rate difference (SRD) between low- and high-income groups remained stable among males (Table 10). Among females the SRD increased by 20% (from 151 to 182 per 100,000) between 1981–84 and 1986–89, although 95% confidence intervals largely overlapped (112 to 189 and 146 to 218, respectively; Table 47), but then remained stable thereafter.

As a consequence of the greater proportionate decreases in mortality among high-income groups compared to low-income groups, *relative* inequalities widened from a rate ratio of 1.43 in 1981–84 to 1.72 in 1996–99 among males, and from 1.27 to 1.50 among females (Table 10; p for trend < 0.01 for both sexes). Given that a ratio of 1.0 equates to no difference between high- and low-income groups, these relative gaps have therefore widened by 67% for males and 85% for females from 1981–84 to 1996–99.[2]

**Table 10:** All-cause mortality relative and absolute measures of inequality, by income, 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | Absolute measures of inequality | |
|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | SRD low:high | SII (95% CI) |
| Males | 25–77 years | 1981–84 | 1.43 | 1.7 (1.6–1.9) | 376 | 547 (384–709) |
| | | 1986–89 | 1.49 | 1.8 (1.7–2.0) | 373 | 540 (400–679) |
| | | 1991–94 | 1.62 | 2.3 (2.1–2.5) | 391 | 632 (591–673) |
| | | 1996–99 | 1.72 | 2.6 (2.4–2.9) | 383 | 616 (491–741) |
| | | *P (trend)* | *< .01* | *0.03* | *0.47* | *0.26* |
| Females | 25–77 years | 1981–84 | 1.27 | 1.5 (1.4–1.6) | 151 | 243 (173–313) |
| | | 1986–89 | 1.37 | 1.6 (1.4–1.7) | 182 | 260 (229–290) |
| | | 1991–94 | 1.45 | 1.9 (1.7–2.1) | 186 | 314 (260–369) |
| | | 1996–99 | 1.50 | 2.2 (1.9–2.4) | 181 | 327 (275–380) |
| | | *P (trend)* | *< .01* | *0.02* | *0.28* | *0.04* |

Notes: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 47. SRDs and SIIs are per 100,000 person-years.

The RII more than doubled (when expressed as a percentage increase considering 1.0 as the null[3]) from 1.7 to 2.6 for males and from 1.5 to 2.2 for females. The SII increased by 13% from 547 to 616 per 100,000 for males and by 35% from 243 to 327 per 100,000 for females (Table 10; p for trend 0.26 and 0.04, respectively). The increased proportion of the cohorts at the extremes of the income distribution by the 1990s explains why the RII and SII increased more over time than did the SRR and SRD.

In summary, absolute inequalities were stable or modestly increasing over time *despite* the overall decline in total population mortality rates. Relative inequalities in mortality by income consequently increased: by 67% for males and 85% for females according to the SRR, and by more than 100% for both genders according to the RII.

[2] For example, 100% × [(1.72 – 1.43)/(1.43 – 1)] = 67%, sometimes called the (percentage) change in the *excess* rate ratio where the excess rate ratio equals [rate ratio minus 1].

[3] (2.6 – 1.7) / (1.7 – 1.0) = 1.28 or 128%.

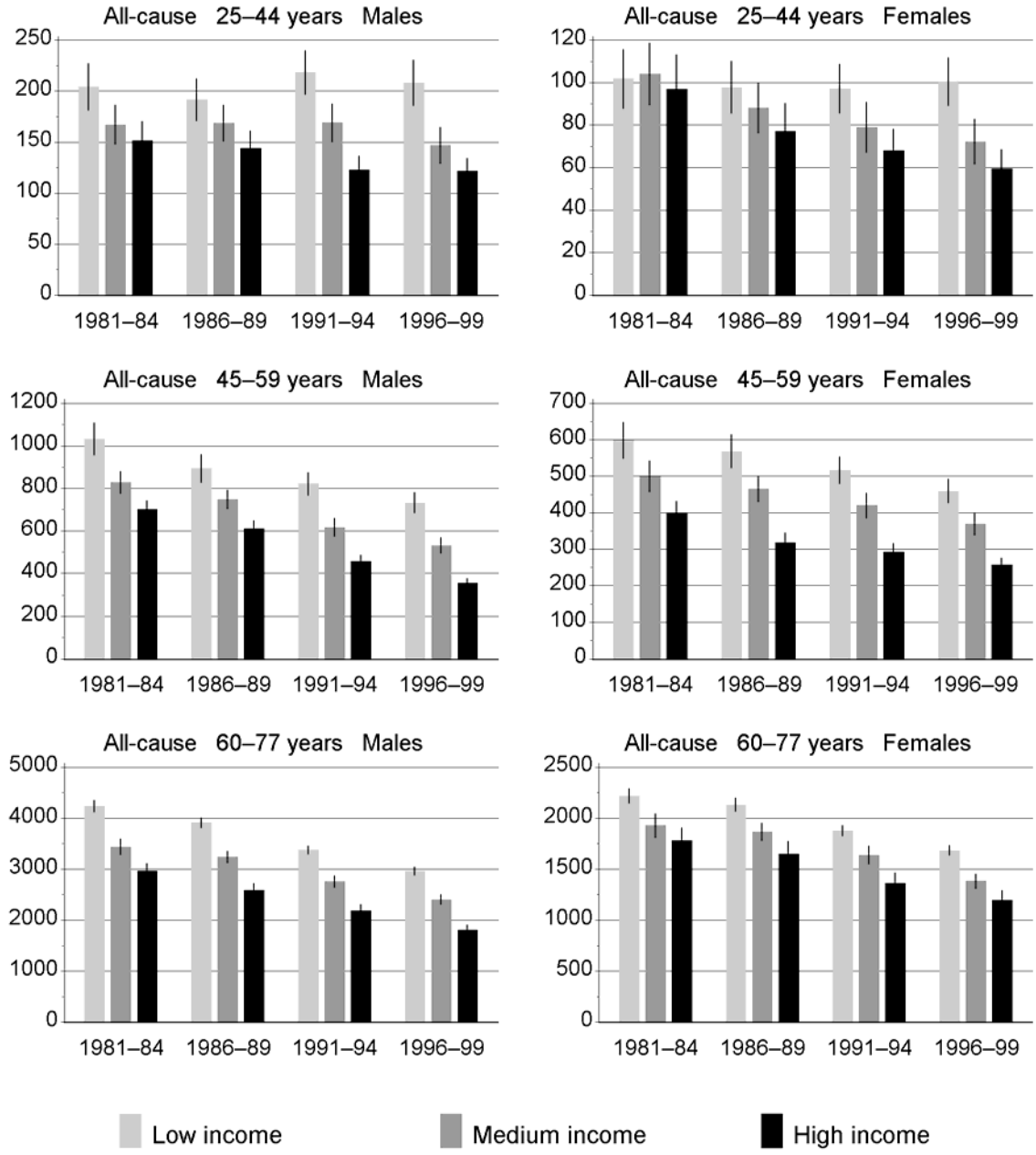
## 4.2 Age-specific rates

Mortality decreased over time among all income groups for all age groups, except low-income 25–44-year-olds, for whom mortality rates did not change or even slightly increased over time (Figure 5).

A gradient of mortality by income was observed for all age groups in each cohort, but tended to be steepest in relative terms among the 45–59 years age group (both sexes; Table 11). Over time there were large increases in relative inequalities (both SRR and RII) for all age groups – particularly among the 25–44 years and 45–59 years age groups. The most notable increase in relative inequality was among 25–44-year-old females. This group had only a modest (if any) income–mortality association in 1981–84 (SRR 1.05, 95%; CI 0.85 to 1.30) but by 1996–99 had a strong income–mortality association (SRR 1.69, 95%; CI 1.40 to 2.04).

There was a pattern of increasing absolute inequalities in mortality over time among young adults (both genders – near-doubling for males and large increase for females), and middle-aged males (10% to 15%), while decreasing among 60–77-year-old males (10% to 15%). However, the statistical test for trend only approached or exceeded conventional criteria for the decrease among older males ($p = 0.15$ and 0.03 for the SRD and SII, respectively) and the increase among 25–44-year-old females ($p < 0.01$ and 0.06, respectively). While 95% confidence intervals largely overlap, it is interesting to note that absolute inequalities in 25–44-year-old male mortality appeared to peak in 1991–94, coinciding with peak levels of unemployment.

**Figure 5:** All-cause mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 46.

**Table 11:** Relative and absolute measures of inequality, all-cause mortality, by income and age

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–44 years | 1981–84 | 1.35 | 1.6 | (1.2–2.1) | 53 | 79 | (35–122) |
| | | 1986–89 | 1.33 | 1.6 | (1.3–2.0) | 48 | 76 | (16–137) |
| | | 1991–94 | 1.78 | 2.7 | (2.0–3.6) | 96 | 151 | (113–189) |
| | | 1996–99 | 1.72 | 2.5 | (1.9–3.4) | 87 | 132 | (70–194) |
| | | *P (trend)* | *0.16* | *0.14* | | *0.20* | *0.18* | |
| | 45–59 years | 1981–84 | 1.48 | 1.8 | (1.6–2.1) | 333 | 458 | (300–616) |
| | | 1986–89 | 1.46 | 1.9 | (1.6–2.2) | 284 | 429 | (371–488) |
| | | 1991–94 | 1.80 | 2.9 | (2.4–3.5) | 364 | 558 | (451–664) |
| | | 1996–99 | 2.07 | 3.3 | (2.7–4.0) | 378 | 514 | (317–710) |
| | | *P (trend)* | *0.06* | *0.06* | | *0.25* | *0.29* | |
| | 60–77 years | 1981–84 | 1.43 | 1.7 | (1.6–1.9) | 1274 | 1931 | (1728–2134) |
| | | 1986–89 | 1.52 | 1.8 | (1.7–1.9) | 1331 | 1911 | (1574–2248) |
| | | 1991–94 | 1.55 | 1.9 | (1.7–2.0) | 1196 | 1791 | (1532–2051) |
| | | 1996–99 | 1.64 | 2.0 | (1.8–2.2) | 1159 | 1680 | (1377–1983) |
| | | *P (trend)* | *0.02* | *< .01* | | *0.15* | *0.03* | |
| Females | 25–44 years | 1981–84 | 1.05 | 1.1 | (0.8–1.4) | 5 | 6 | (-14–26) |
| | | 1986–89 | 1.27 | 1.4 | (1.1–1.9) | 21 | 30 | (11–50) |
| | | 1991–94 | 1.43 | 1.9 | (1.4–2.6) | 29 | 50 | (46–54) |
| | | 1996–99 | 1.69 | 2.2 | (1.6–3.1) | 41 | 59 | (51–68) |
| | | *P (trend)* | *< .01* | *< .01* | | *< .01* | *0.06* | |
| | 45–59 years | 1981–84 | 1.50 | 2.0 | (1.6–2.4) | 200 | 306 | (233–378) |
| | | 1986–89 | 1.79 | 2.7 | (2.1–3.3) | 251 | 386 | (344–427) |
| | | 1991–94 | 1.77 | 2.6 | (2.1–3.2) | 225 | 343 | (294–392) |
| | | 1996–99 | 1.79 | 3.0 | (2.4–3.7) | 203 | 330 | (263–398) |
| | | *P (trend)* | *0.23* | *0.10* | | *0.69* | *0.85* | |
| | 60–77 years | 1981–84 | 1.25 | 1.5 | (1.3–1.6) | 440 | 779 | (538–1020) |
| | | 1986–89 | 1.29 | 1.4 | (1.3–1.5) | 485 | 627 | (530–724) |
| | | 1991–94 | 1.38 | 1.5 | (1.3–1.6) | 514 | 660 | (490–830) |
| | | 1996–99 | 1.41 | 1.7 | (1.5–1.8) | 488 | 764 | (514–1014) |
| | | *P (trend)* | *0.02* | *0.27* | | *0.36* | *0.84* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 47.

## 4.3 Excess deaths and potential years of life lost

The excess number of deaths per year are those that would not have occurred had the mortality rate of the high-income group (using the three-level category with same real dollar cut-points over time) applied to both the middle- and low-income categories. Results are shown in Table 12 below. It is evident that both the number of deaths that are attributable to less than high income are large, and that the burden attributable to income is increasing over time. Some of that increase over time was due to a growing and ageing population, but much of that increase was also due to the increasing strength of the income–mortality association among young adults.

The total estimated number of excess deaths attributable to low and medium income (compared to high income) was approximately 3700 per year in 1996–99. This estimate corresponds reasonably well with the estimate of 4800 deaths per year attributable to small-area deprivation during 1996–98 (Ministry of Health 2004), bearing in mind that this latter estimate covers all ages (not just 25–77 years).

**Table 12:** Excess number of deaths per year attributable to medium and low income, using the high-income group as the reference

| Sex | Age group | 1981–84 | 1986–89 | 1991–94 | 1996–99 |
|---|---|---|---|---|---|
| Males | 25–44 years | 86 | 101 | 187 | 162 |
| | 45–59 years | 211 | 237 | 338 | 364 |
| | 60–77 years | 1449 | 1892 | 1840 | 1788 |
| | 25–77 years | 1746 | 2230 | 2364 | 2315 |
| Females | 25–44 years | 20 | 54 | 69 | 106 |
| | 45–59 years | 183 | 265 | 274 | 257 |
| | 60–77 years | 807 | 1028 | 984 | 1006 |
| | 25–77 years | 1010 | 1347 | 1327 | 1369 |

Note: Excess deaths per year pertain to the observed person-time and deaths in each census cohort.

The potential years of life lost (PYLL) per 100,000 people are shown in Table 13 below. The PYLLs were consistently greater in the low-income group. Consistent with the relative and absolute differences in mortality rates presented above, the absolute differences in PYLLs between low- and high-income groups remain reasonably constant over time while the relative differences increased over time. For example, the PYLLs per 100,000 in the low-income group were 45% and 29% greater than in the high-income group in 1981–84 for males and females, respectively. By 1996–99, the PYLLs were 77% and 57% greater among the low-income group.

**Table 13:** Potential years of life lost (PYLL) per 100,000* among 25–77-year-olds, by income, and relative and absolute differences in PYLLs for low- and medium-income groups compared to the high-income group

| | | PYLL | | | Relative risk of PYLL | | Absolute differences in PYLL | |
|---|---|---|---|---|---|---|---|---|
| | | Low income | Medium income | High income | Low cf high income | Medium cf high income | Low cf high income | Medium cf high income |
| Males | 1981–84 | 18,902 | 15,216 | 13,023 | 1.45 | 1.17 | 5,879 | 2,193 |
| | 1986–89 | 17,181 | 14,317 | 11,486 | 1.50 | 1.25 | 5,695 | 2,831 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1991–94 | 15,751 | 12,439 | 9,448 | 1.67 | 1.32 | 6,303 | 2,991 |
| | 1996–99 | 14,147 | 10,788 | 7,980 | 1.77 | 1.35 | 6,167 | 2,808 |
| Females | 1981–84 | 10,308 | 9,017 | 7,971 | 1.29 | 1.13 | 2,337 | 1,046 |
| | 1986–89 | 9,842 | 8,487 | 6,939 | 1.42 | 1.22 | 2,903 | 1,548 |
| | 1991–94 | 8,904 | 7,486 | 5,977 | 1.49 | 1.25 | 2,927 | 1,509 |
| | 1996–99 | 8,143 | 6,541 | 5,198 | 1.57 | 1.26 | 2,945 | 1,343 |

* The PYLLs are standardised to the 1991 census age distribution.

## 4.4 Life expectancy

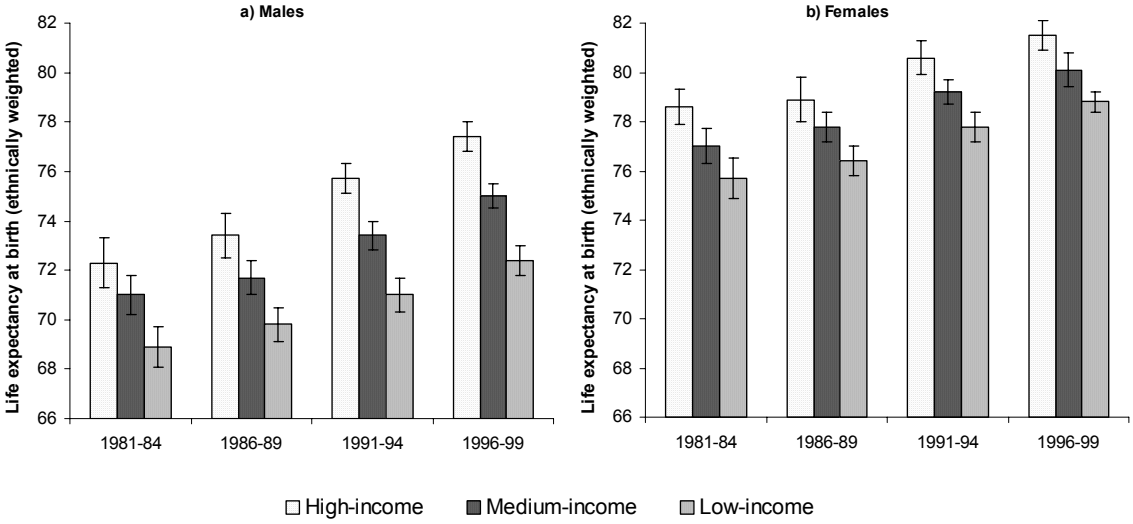
Table 14 shows the life expectancy at birth, weighted for ethnicity (as described in the Methods chapter) to be consistent with the ethnic standardisation used elsewhere in this report when calculating mortality rates. (The ethnically weighted results were not, in fact, markedly different from non-weighted life expectancies. The latter are available from the authors on request.)

**Table 14:** Ethnically-weighted life expectancy at birth, by income and sex, 1981–84 to 1996–99

| Income category | 1981–84 | | 1986–89 | | 1991–94 | | 1996–99 | |
|---|---|---|---|---|---|---|---|---|
| **Males** | | | | | | | | |
| High | 72.3 | (71.3–73.3) | 73.4 | (72.5–74.3) | 75.7 | (75.1–76.3) | 77.4 | (76.8–78.0) |
| Medium | 71.0 | (70.2–71.8) | 71.7 | (71.0–72.4) | 73.4 | (72.8–74.0) | 75.0 | (74.5–75.5) |
| Low | 68.9 | (68.1–69.7) | 69.8 | (69.1–70.5) | 71.0 | (70.3–71.7) | 72.4 | (71.8–73.0) |
| Missing | 69.2 | (68.4–70.0) | 69.6 | (68.9–70.3) | 71.8 | (71.1–72.5) | 74.1 | (73.4–74.8) |
| All categories | 70.3 | (69.9–70.7) | 71.1 | (70.7–71.5) | 72.8 | (72.5–73.1) | 74.5 | (74.2–74.8) |
| **Females** | | | | | | | | |
| High | 78.6 | (77.9–79.3) | 78.9 | (78.0–79.8) | 80.6 | (79.9–81.3) | 81.5 | (80.9–82.1) |
| Medium | 77.0 | (76.3–77.7) | 77.8 | (77.2–78.4) | 79.2 | (78.7–79.7) | 80.1 | (79.4–80.8) |
| Low | 75.7 | (74.9–76.5) | 76.4 | (75.8–77.0) | 77.8 | (77.2–78.4) | 78.8 | (78.4–79.2) |
| Missing | 74.8 | (74.0–75.7) | 74.3 | (73.3–75.3) | 76.2 | (75.5–76.9) | 78.3 | (77.7–78.9) |
| All categories | 76.3 | (75.7–76.9) | 77.0 | (76.7–77.3) | 78.5 | (78.2–78.8) | 79.5 | (79.2–79.8) |

Plotting the ethnically weighted life expectancies at birth (Figure 6 below) using the same y-axis scale for males and females, it is evident that good gains in life expectancy were made in all income groups during the 1980s to 1990s – particularly among males. The gap in life expectancy between low- and high-income groups was consistently greater for males than for females.

**Figure 6:** Life expectancy at birth (ethnically weighted), by income and sex, 1981–84 to 1996–99




Note: Error bars are 95% confidence intervals.

Figure 6 also gives the visual impression of widening gaps in life expectancy by income among males over time, but not among females. This is confirmed in Table 15 below. For males the gap in ethnically weighted life expectancy increased by 1.6 years, from 3.4 years in 1981–84 to 5.0 years in 1996–99. In comparison, for females, the life expectancy gap after weighting for ethnicity narrowed slightly by 0.2 years, although any narrowing was much less than the estimated 95% confidence interval of -1.4 to 1.0 years.

**Table 15:** Trends in ethnically weighted life expectancy at birth within income groups, and in gaps between high- and low-income groups, 1981–84 to 1996–99

| | Males | | Females | |
|---|---|---|---|---|
| | Years | % change | Years | % change |
| Increase in LE for high-income group from 1981–84 to 1996–99 | 5.1 (4.0–6.2) | 7.1% (6.2–8.7) | 2.9 (2.1–3.7) | 3.7% (2.7–4.7) |
| Increase in LE for low-income group from 1981–84 to 1996–99 | 3.5 (2.5–4.5) | 5.1% (3.5–6.3) | 3.1 (2.2–4.0) | 4.0% (2.8–5.2) |
| High-low income gap 1981–84 | 3.4 (2.1–4.7) | | 2.9 (1.9–3.9) | |
| High-low income gap 1996–99 | 5.0 (4.2–5.8) | | 2.7 (2.0–3.4) | |
| Change in gap from 1981–84 to 1996–99 | 1.6 (0.1–3.1) | | -0.2 (-1.4–1.0) | |

### 4.4.1 Probabilities of surviving different life-cycle stages

Life expectancies are calculated by summing the probabilities of surviving across all ages (either single years of age or five-year age groups). Just as it is useful to look at age-specific mortality rates in addition to overall age-standardised mortality rates, it is also useful to examine the pattern of survival probabilities by income for different stages of the life-cycle. As few people die at a young age, survival probabilities are usually just less than 1.0 at young ages.

Table 16 below shows survival probabilities by sex, income and age (without using ethnic weighting). As would be expected based on the mortality rates, there was a relatively uniform gradient in survival probabilities across the three income groups. While notable differences in survival by income exist at younger ages, survival probabilities only start falling substantially below 1.0 in middle age. So mortality in younger age groups makes little contribution to the income gradients in *survival* in all periods. In fact, inspection of the table shows that the major contribution to the income gradients comes from the lower – and varying – probabilities of surviving middle age and old age. The difference in survival probability between low- and high-income groups among 45–65 and 65–75-year-olds was sizeable during all periods. For example, differences in survival probabilities from 45 to 65 years and from 65 to 75 years between low- and high-income males were usually about 0.1, and for females were about 0.05.

**Table 16:** Probability of survival, by life-cycle stage, income group and sex, 1981–84 to 1996–99

| Income category | Male | | | | Female | | | |
|---|---|---|---|---|---|---|---|---|
| | 1981–84 | 1986–89 | 1991–94 | 1996–99 | 1981–84 | 1986–89 | 1991–94 | 1996–99 |
| **Ages 0–15** | | | | | | | | |
| High | 0.9832 | 0.9860 | 0.9926 | 0.9917 | 0.9941 | 0.9885 | 0.9930 | 0.9951 |
| Medium | 0.9840 | 0.9865 | 0.9905 | 0.9928 | 0.9865 | 0.9911 | 0.9937 | 0.9897 |
| Low | 0.9780 | 0.9811 | 0.9834 | 0.9872 | 0.9823 | 0.9869 | 0.9892 | 0.9910 |
| All categories* | 0.9805 | 0.9826 | 0.9863 | 0.9886 | 0.9848 | 0.9864 | 0.9899 | 0.9905 |
| **Ages 15–25** | | | | | | | | |
| High | 0.9863 | 0.9846 | 0.9873 | 0.9895 | 0.9946 | 0.9951 | 0.9959 | 0.9949 |
| Medium | 0.9847 | 0.9828 | 0.9829 | 0.9873 | 0.9947 | 0.9942 | 0.9952 | 0.9949 |
| Low | 0.9854 | 0.9835 | 0.9837 | 0.9859 | 0.9937 | 0.9923 | 0.9940 | 0.9945 |
| All categories* | 0.9850 | 0.9836 | 0.9851 | 0.9874 | 0.9943 | 0.9941 | 0.9947 | 0.9947 |
| **Ages 25–45** | | | | | | | | |
| High | 0.9721 | 0.9722 | 0.9761 | 0.9765 | 0.9818 | 0.9852 | 0.9871 | 0.9890 |
| Medium | 0.9671 | 0.9664 | 0.9661 | 0.9701 | 0.9805 | 0.9822 | 0.9848 | 0.9855 |
| Low | 0.9574 | 0.9611 | 0.9546 | 0.9562 | 0.9784 | 0.9793 | 0.9788 | 0.9777 |
| All categories* | 0.9659 | 0.9656 | 0.9664 | 0.9689 | 0.9785 | 0.9811 | 0.9823 | 0.9836 |
| **Ages 45–65** | | | | | | | | |
| High | 0.830 | 0.854 | 0.885 | 0.905 | 0.906 | 0.917 | 0.927 | 0.936 |
| Medium | 0.797 | 0.811 | 0.839 | 0.858 | 0.880 | 0.884 | 0.897 | 0.905 |
| Low | 0.734 | 0.761 | 0.783 | 0.796 | 0.850 | 0.860 | 0.867 | 0.879 |
| All categories* | 0.789 | 0.809 | 0.835 | 0.858 | 0.875 | 0.881 | 0.892 | 0.904 |
| **Ages 65–75** | | | | | | | | |
| High | 0.724 | 0.754 | 0.791 | 0.809 | 0.824 | 0.843 | 0.862 | 0.881 |
| Medium | 0.669 | 0.691 | 0.722 | 0.750 | 0.821 | 0.821 | 0.840 | 0.856 |
| Low | 0.617 | 0.641 | 0.679 | 0.719 | 0.782 | 0.793 | 0.815 | 0.833 |
| All categories* | 0.642 | 0.663 | 0.700 | 0.738 | 0.786 | 0.797 | 0.819 | 0.837 |

* Includes census respondents with missing income data.

# Chapter 5: Avoidable, Amenable and Non-avoidable Mortality

For guidance on the inequality measures used, see 'Guide to understanding trends in SRDs, SRRs, SIIs, and RIIs' (page 23).

Avoidable and amenable causes of death are defined in section 2.1.8 of the Methods chapter (page 15). Briefly, avoidable deaths are those that could theoretically have been avoided, through prevention or treatment, given current understanding of causation and currently available disease prevention and health care technologies. Amenable causes are those that, with current medical treatment should not result in death. That is, even where the disease is not prevented, the case fatality of the disease can still be minimised through health care.

## 5.1 Age-standardised rates (25–77 years)

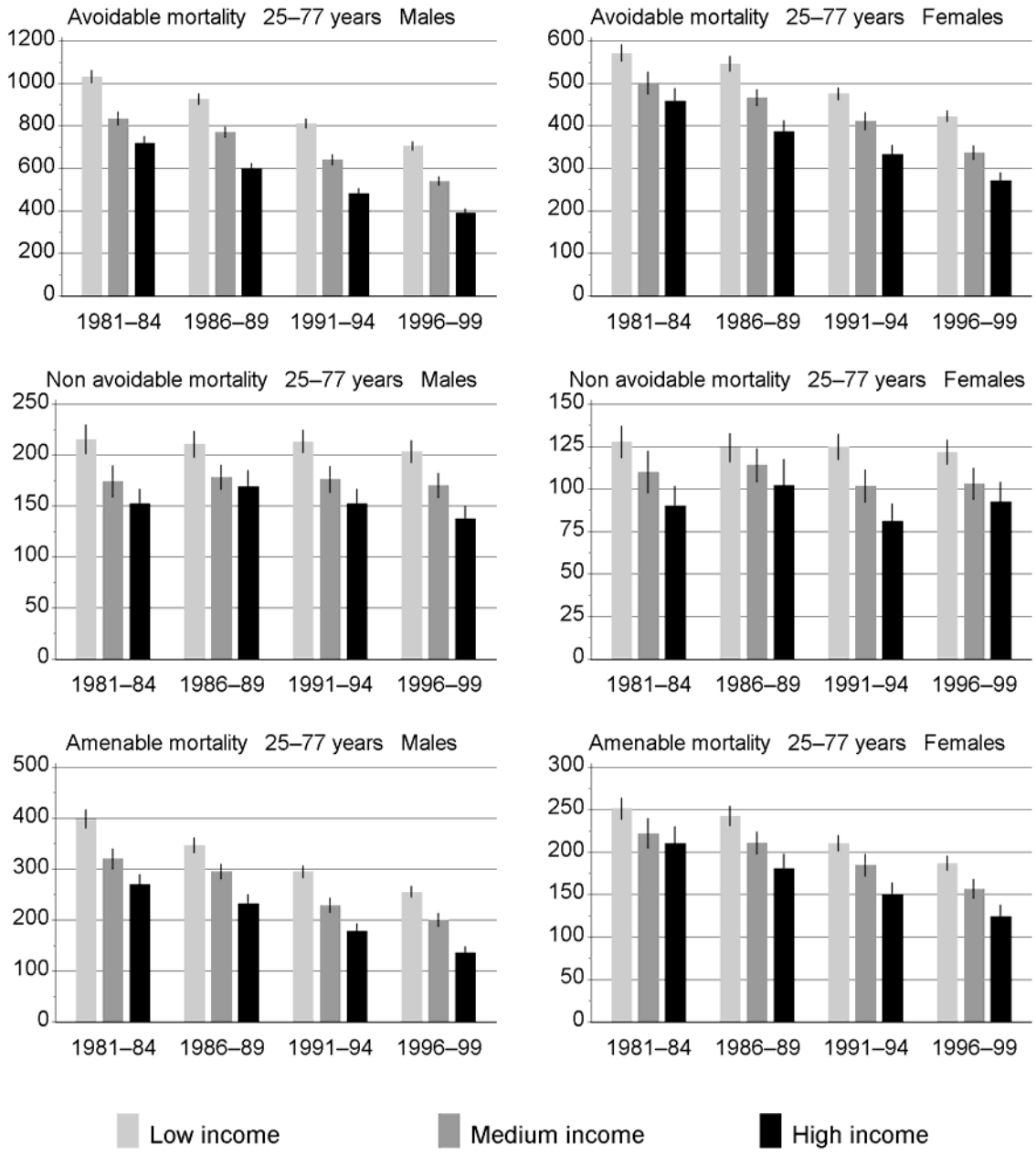
Low income was associated with higher mortality rates for avoidable, amenable and non-avoidable mortality in all periods.

Mortality rates for non-avoidable causes did not decrease over time in any income group. However, rates of avoidable mortality and mortality amenable to medical intervention declined sharply during the 1980s and 1990s (Figure 7). These declines were approximately equal in absolute terms for all income groups, but were greatest in percentage terms for the high-income group. As a result, the SRD (comparing low- to high-income groups) and SII tended to remain stable over time for both avoidable and amenable mortality. The only exception was for amenable mortality among females, where a statistically significant increase in SII and a non-significant increase in SRD were found (Table 17).

At the same time, there was a significant steepening trend of the income gradient in *relative* terms for both avoidable and amenable mortality, for both males and females. For *avoidable mortality* among males, the SRR (comparing low- to high-income groups) increased 84% from 1.44 to 1.81 while the RII more than doubled from 1.9 to 3.3 (Table 17). For females, the SRR more than doubled from 1.25 to 1.56 and the RII increased by a similar percentage from 1.6 to 2.4.

For *amenable mortality*, the SRR among males increased by 83% from 1.48 to 1.88 while the RII more than doubled from 2.1 to 3.9. Relative inequality was again lower among females, but showed similar trends to males, with the SRR increasing from 1.20 to 1.51 and the RII increasing from 1.5 to 2.3. Trends in inequalities were thus similar for both avoidable and amenable mortality in both sexes.

**Figure 7:** Avoidable, non-avoidable and amenable mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Tables 48, 50 and 52.

**Table 17:** Relative and absolute measures of inequality by income, avoidable, amenable and non-avoidable mortality for 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | Absolute measures of inequality | |
|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | SRD low:high | SII (95% CI) |
| **Avoidable** | | | | | | |
| Males | 25–77 years | 1981–84 | 1.44 | 1.9 (1.8–2.1) | 313 | 696 (494–898) |
| | | 1986–89 | 1.55 | 2.1 (2.0–2.3) | 331 | 697 (539–854) |
| | | 1991–94 | 1.69 | 2.7 (2.5–3.0) | 330 | 758 (692–824) |
| | | 1996–99 | 1.81 | 3.3 (3.0–3.6) | 316 | 726 (611–840) |
| | | *P (trend)* | *< .01* | *0.02* | *0.89* | *0.58* |
| Females | 25–77 years | 1981–84 | 1.25 | 1.6 (1.4–1.7) | 113 | 285 (204–366) |
| | | 1986–89 | 1.41 | 1.8 (1.7–2.0) | 159 | 354 (316–393) |
| | | 1991–94 | 1.43 | 1.9 (1.8–2.1) | 143 | 340 (292–387) |
| | | 1996–99 | 1.56 | 2.4 (2.2–2.7) | 152 | 376 (319–433) |
| | | *P (trend)* | *0.04* | *0.03* | *0.40* | *0.31* |
| **Amenable** | | | | | | |
| Males | 25–77 years | 1981–84 | 1.48 | 2.1 (1.8–2.3) | 129 | 292 (206–377) |
| | | 1986–89 | 1.50 | 2.0 (1.8–2.2) | 115 | 249 (178–319) |
| | | 1991–94 | 1.66 | 2.7 (2.4–3.1) | 117 | 276 (236–316) |
| | | 1996–99 | 1.88 | 3.9 (3.3–4.7) | 119 | 294 (231–356) |
| | | *P (trend)* | *0.06* | *0.11* | *0.56* | *0.63* |
| Females | 25–77 years | 1981–84 | 1.20 | 1.5 (1.3–1.7) | 41 | 109 (63–155) |
| | | 1986–89 | 1.35 | 1.7 (1.5–1.9) | 62 | 138 (101–176) |
| | | 1991–94 | 1.40 | 1.8 (1.6–2.0) | 61 | 136 (93–179) |
| | | 1996–99 | 1.51 | 2.3 (2.0–2.7) | 63 | 162 (121–204) |
| | | *P (trend)* | *0.02* | *0.03* | *0.23* | *0.08* |
| **Non-avoidable** | | | | | | |
| Males | 25–77 years | 1981–84 | 1.42 | 1.8 (1.6–2.2) | 63 | 136 (78–194) |
| | | 1986–89 | 1.25 | 1.5 (1.3–1.7) | 42 | 89 (30–147) |
| | | 1991–94 | 1.40 | 1.9 (1.6–2.2) | 61 | 145 (117–173) |
| | | 1996–99 | 1.48 | 2.0 (1.8–2.3) | 66 | 149 (106–192) |
| | | *P (trend)* | *0.51* | *0.44* | *0.59* | *0.47* |
| Females | 25–77 years | 1981–84 | 1.42 | 2.1 (1.7–2.6) | 38 | 100 (80–120) |
| | | 1986–89 | 1.22 | 1.4 (1.1–1.6) | 22 | 45 (13–76) |
| | | 1991–94 | 1.54 | 2.2 (1.8–2.6) | 44 | 100 (81–119) |
| | | 1996–99 | 1.32 | 2.0 (1.7–2.4) | 29 | 92 (60–124) |
| | | *P (trend)* | *0.99* | *0.71* | *0.91* | *0.98* |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Tables 49, 51 and 53.

## 5.2 Age-specific rates

The rates, SRDs and SRRs for avoidable, non-avoidable and amenable mortality for each age group, together with confidence intervals, can be found in the Appendix, Tables 48 to 53. Mortality rates for avoidable and amenable mortality fell in all age by income groups for both males and females.

Given that approximately 80% of all deaths under age 75 are categorised as avoidable deaths, the patterns for avoidable mortality by age are not too dissimilar to those for all-cause mortality. All age groups experienced increases in the SRR for low compared to high income for both avoidable and amenable mortality. The most notable increase in relative inequality was for avoidable mortality among 25–44-year-old females, with the SRR increasing from 1.07 (95% CI 0.84 to 1.36) in 1981–84 to 1.79 (1.44 to 2.22) in 1996–99.

# Chapter 6: Cardiovascular Disease

For guidance on the inequality measures used, see 'Guide to understanding trends in SRDs, SRRs, SIIs, and RIIs' (page 23).

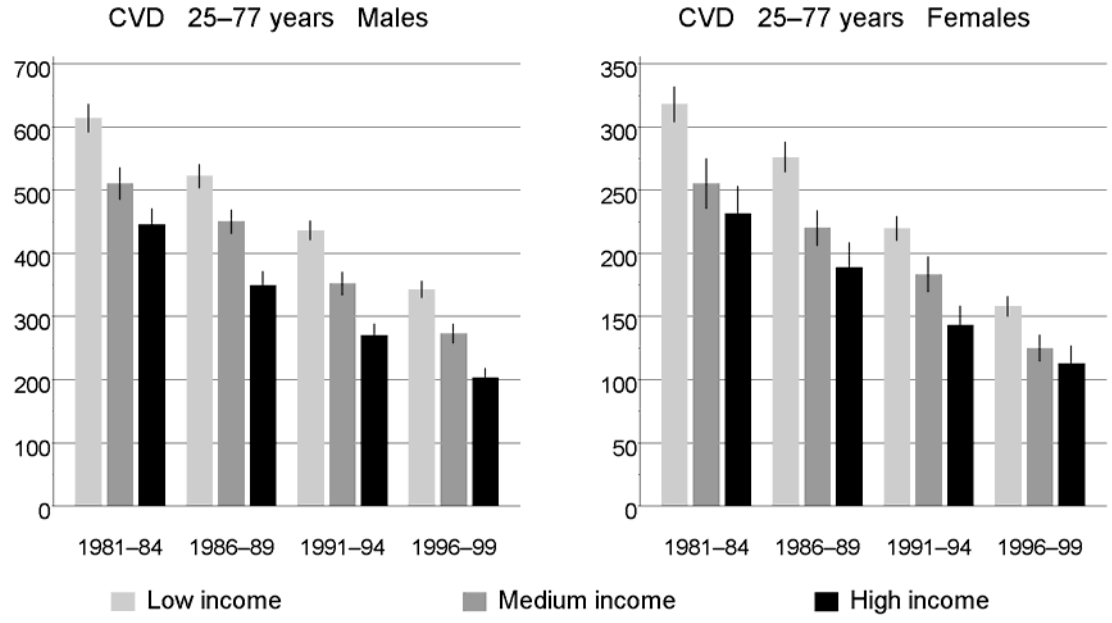
## 6.1 Cardiovascular disease combined

### 6.1.1 Age-standardised rates (25–77 years)

Cardiovascular mortality rates declined by about half over the study period among all income groups for both males and females. Further, cardiovascular mortality rates were strongly associated with income level in all four periods. Thus we have the conditions necessary for diverging trends in absolute and relative inequalities over time.

For both males and females, absolute inequality, measured by the SRD, was constant until 1991–94 but then declined by 15% for males, from 167 (95% CI 143 to 190 ) to 140 (95% CI 120 to 160); and by 40% for females, from 77 (95% CI 59 to 95) to 46 (95% CI 29 to 62). *A priori* it seems likely that absolute inequalities in mortality will decrease at some point in the face of large overall declines in mortality (Figure 8 below). This pattern is consistent with the later stages of a CVD mortality epidemic that was out of phase by socioeconomic position, or, more generally, the inverse equity hypothesis (see section 1.7). Therefore, this decline in absolute inequalities in the 1990s should not be simply dismissed as due to chance, despite overlapping confidence intervals.

**Figure 8:** Cardiovascular disease mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 54.

For females relative inequality, measured by the SRR, was much the same in 1981–84 as it was in 1996–99, although arguably relative inequalities for females peaked in 1986–89 and 1991–94. Again, such peaking would not be inconsistent with *a priori* expectations. However, the RII among females increased from 1.7 in both 1981–84 and 1986–89 to 2.1 in both 1991–94 and 1996–99. At the same time, relative inequality increased steadily for males; the SRR increased from 1.38 to 1.69 and the RII from 1.6 to 2.7. It may be that the CVD mortality epidemic among males has not yet reached the point where relative (as well as absolute) inequalities start to decline.

**Table 18:** Cardiovascular disease relative and absolute measures of inequality, by income, 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | Absolute measures of inequality | |
|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | SRD low:high | SII (95% CI) |
| Males | 25–77 years | 1981–84 | 1.38 | 1.6 (1.4–1.8) | 168 | 229 (145–312) |
| | | 1986–89 | 1.50 | 1.8 (1.7–2.0) | 173 | 255 (190–320) |
| | | 1991–94 | 1.62 | 2.3 (2.1–2.6) | 167 | 273 (246–300) |
| | | 1996–99 | 1.69 | 2.7 (2.3–3.1) | 140 | 237 (182–293) |
| | | *P (trend)* | *< .01* | *< .01* | *0.16* | *0.88* |
| Females | 25–77 years | 1981–84 | 1.38 | 1.7 (1.4–2.0) | 87 | 135 (94–177) |
| | | 1986–89 | 1.46 | 1.7 (1.5–2.0) | 87 | 118 (104–132) |
| | | 1991–94 | 1.54 | 2.1 (1.8–2.5) | 77 | 133 (81–184) |
| | | 1996–99 | 1.40 | 2.1 (1.7–2.6) | 46 | 93 (65–122) |
| | | *P (trend)* | *0.60* | *0.12* | *0.10* | *0.15* |

Notes: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 55.

### 6.1.2 Age-specific rates

Examining the age-specific CVD trends, there were marked differences between age groups (Figure 9 and Table 19).

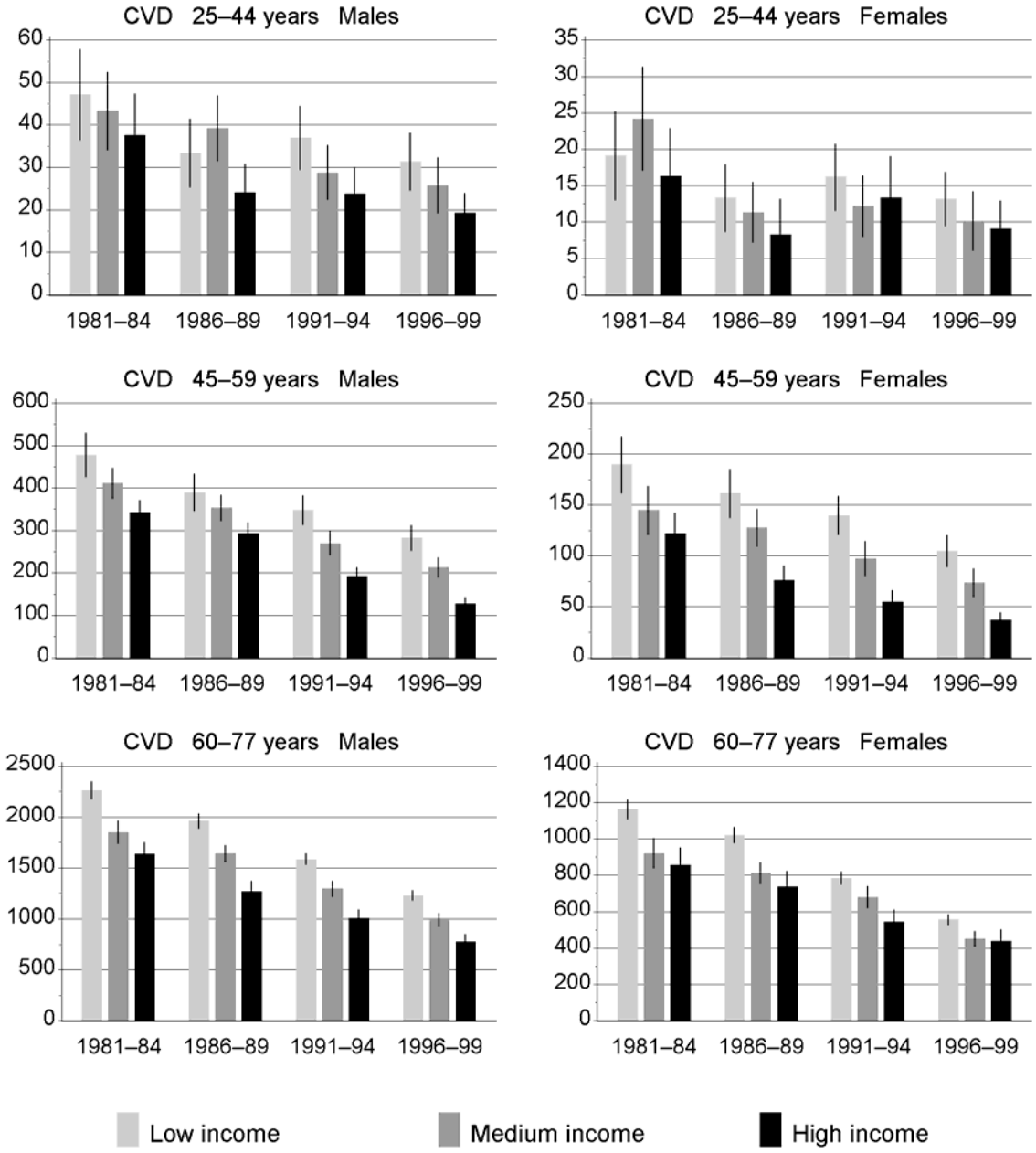
- Among 25–44-year-olds CVD mortality rates by income are measured with considerable imprecision (wide error bars or 95% confidence intervals), especially for females. Nevertheless, for males CVD mortality declined over time with a trend towards increasing SRRs.
- Among 45–59-year-olds, rates are falling dramatically and roughly in parallel in all income groups, for both sexes. Therefore, the SRDs are reasonably constant over time, although perhaps widening for males and perhaps peaking for females in 1986–89 to 1991–94. In parallel, relative inequalities tripled for both males and females as measured by the increase in the SRR (treating 1.0 as the null). Compared to the younger and older age groups, relative inequalities in CVD mortality are highest in this age group, and also tended to increase the most.

- There were also dramatic decreases in 60–77-year-olds' CVD mortality in all income groups for both males and females. Absolute inequalities as measured by the SRD decreased consistently over time for females, becoming 60% less in 1996–99 than in 1981–84 (p for trend 0.07). Among males, the absolute inequality increased from 1981–84 to 1986–89, then steadily decreased by a third until 1996–99.[4] Given the decreasing SRDs over time among 60–77-year-olds, the SRRs were reasonably constant over time.

What further information do the RII and SII convey? Allowing for the widening income distribution over the 1980s and 1990s, they are roughly consistent with the SRR and SRD trends. That is, for example, the RIIs increased more over time than the SRRs. Of note, the SII more than halved over time for 60–77-year-old females.

[4] Wide confidence intervals and having only four time periods to compare limits our ability to make strong conclusions about the statistical significance of any rise then fall in the SRD for 60–77-year-old males. However, a linear regression model of the SRDs on year and year-squared produced a coefficient for the latter year-squared term with a p value of 0.08. Thus, there was partial statistical support for a non-linear trend in the SRDs which, when put alongside our *a priori* expectations articulated in section 1.7, suggests that a non-linear trend should not be dismissed as purely a chance finding.

**Figure 9:** Cardiovascular disease mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 54.

**Table 19:** Cardiovascular disease relative and absolute measures of inequality, by income and age

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–44 years | 1981–84 | 1.25 | 1.4 | (0.9–2.4) | 10 | 15 | (9–22) |
| | | 1986–89 | 1.39 | 1.7 | (1.0–2.9) | 9 | 17 | (1–33) |
| | | 1991–94 | 1.56 | 2.5 | (1.4–4.4) | 13 | 24 | (16–32) |
| | | 1996–99 | 1.64 | 2.5 | (1.4–4.7) | 12 | 21 | (15–27) |
| | | *P (trend)* | *< .01* | *0.04* | | *0.24* | *0.20* | |
| | 45–59 years | 1981–84 | 1.40 | 1.6 | (1.3–1.9) | 136 | 169 | (90–248) |
| | | 1986–89 | 1.33 | 1.6 | (1.3–2.0) | 97 | 160 | (133–188) |
| | | 1991–94 | 1.81 | 2.9 | (2.2–3.9) | 156 | 244 | (199–290) |
| | | 1996–99 | 2.21 | 3.8 | (2.7–5.5) | 155 | 213 | (152–275) |
| | | *P (trend)* | *0.08* | *0.07* | | *0.36* | *0.26* | |
| | 60–77 years | 1981–84 | 1.38 | 1.6 | (1.4–1.8) | 622 | 889 | (737–1042) |
| | | 1986–89 | 1.55 | 1.8 | (1.6–2.0) | 694 | 980 | (706–1254) |
| | | 1991–94 | 1.58 | 2.0 | (1.7–2.2) | 580 | 891 | (789–994) |
| | | 1996–99 | 1.58 | 2.0 | (1.8–2.3) | 453 | 699 | (549–848) |
| | | *P (trend)* | *0.14* | *0.06* | | *0.17* | *0.34* | |
| Females | 25–44 years | 1981–84 | 1.17 | 1.0 | (0.5–2.0) | 3 | 1 | (-5–6) |
| | | 1986–89 | 1.60 | 2.1 | (0.8–5.4) | 5 | 8 | (-2–18) |
| | | 1991–94 | 1.21 | 1.9 | (0.8–4.2) | 3 | 8 | (2–15) |
| | | 1996–99 | 1.46 | 1.4 | (0.6–3.0) | 4 | 3 | (-5–11) |
| | | *P (trend)* | *0.57* | *0.57* | | *0.89* | *0.51* | |
| | 45–59 years | 1981–84 | 1.55 | 1.9 | (1.3–2.7) | 68 | 88 | (20–155) |
| | | 1986–89 | 2.13 | 4.3 | (2.4–7.6) | 86 | 140 | (102–179) |
| | | 1991–94 | 2.56 | 6.9 | (3.0–16.1) | 85 | 131 | (93–170) |
| | | 1996–99 | 2.85 | 8.4 | (2.9–24.2) | 68 | 100 | (74–127) |
| | | *P (trend)* | *0.01* | *0.03* | | *0.64* | *0.53* | |
| | 60–77 years | 1981–84 | 1.36 | 1.7 | (1.5–2.0) | 306 | 533 | (461–605) |
| | | 1986–89 | 1.38 | 1.6 | (1.4–1.8) | 284 | 393 | (337–450) |
| | | 1991–94 | 1.44 | 1.5 | (1.3–1.7) | 242 | 283 | (165–400) |
| | | 1996–99 | 1.27 | 1.6 | (1.4–1.9) | 118 | 242 | (110–375) |
| | | *P (trend)* | *0.74* | *0.57* | | *0.07* | *0.03* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 55.

## 6.2 Ischaemic heart disease

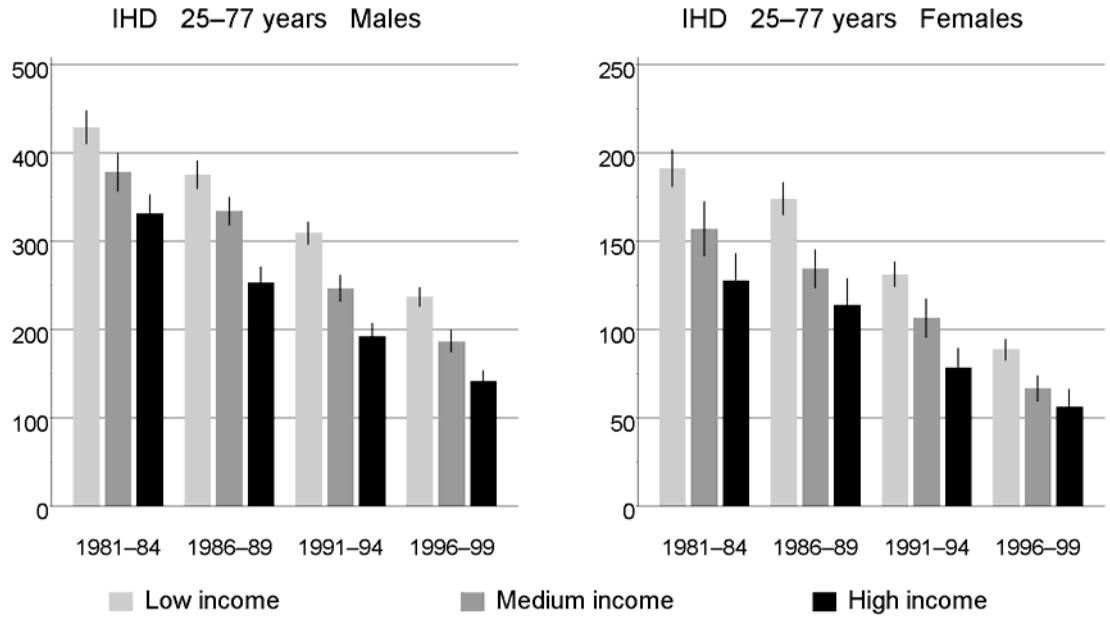
### 6.2.1 Age-standardised rates (25–77 years)

As ischaemic heart disease mortality made up approximately three-quarters of male CVD mortality and two-thirds of female CVD mortality, the patterns for IHD mortality by income largely follow those described above for CVD mortality.

All income groups (both sexes) enjoyed dramatic reductions in IHD mortality rates over time, although the rate of decline was slightly greater for the high-income groups. Absolute inequality among females decreased over time by half for the SRD and by a third for SII, with most of the decrease occurring between 1991–94 and 1996–99. Absolute inequality among males appeared to peak in 1986–89 to 1991–94 according to both SRD and SII measures.[5] This evidence for peaking of absolute inequalities among males was stronger for IHD than for all CVD combined (see section 6.1).

In contrast, relative inequalities monotonically increased among males from 1.29 to 1.68 using the SRR, and from 1.4 to 2.6 using the RII. Among females, the SRR was reasonably constant over time and the RII increased from 1.9 to 2.6 (p for trend 0.18). These trends in relative inequality for IHD were similar to those reported above for CVD.

**Figure 10:** Ischaemic heart disease mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 56.

[5] As a crude test of a non-linear trend in the SRDs (and SIIs), a linear regression model of the SRD (SII) on year and year-squared was fitted. The coefficient for the latter year-squared term among males had a p-value of 0.10 (0.04), offering some support for a non-linear association.

**Table 20:** Ischaemic heart disease relative and absolute measures of inequality, by income, 25–77-year-olds combined

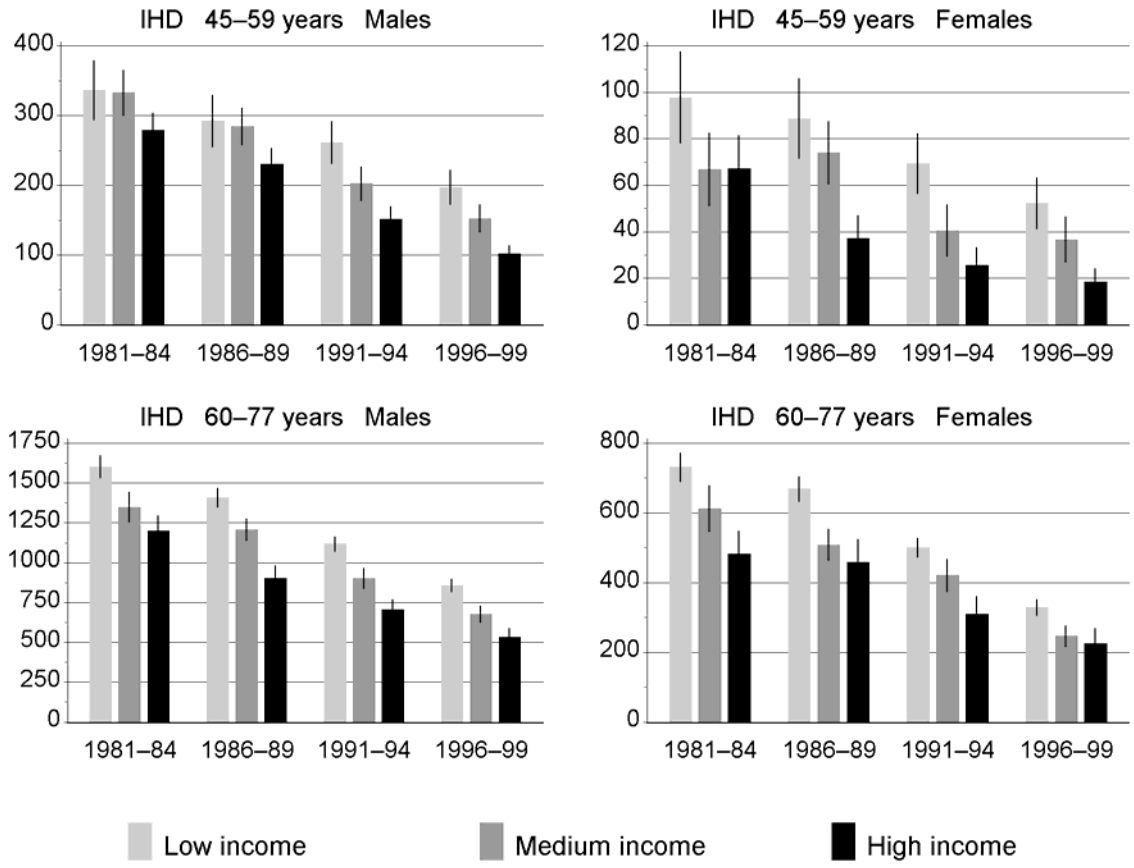
| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.29 | 1.4 | (1.2–1.6) | 97 | 124 | (62–186) |
| | | 1986–89 | 1.49 | 1.8 | (1.6–2.0) | 123 | 181 | (144–218) |
| | | 1991–94 | 1.61 | 2.3 | (2.0–2.6) | 117 | 189 | (166–213) |
| | | 1996–99 | 1.68 | 2.6 | (2.2–3.1) | 96 | 161 | (116–205) |
| | | *P (trend)* | *0.02* | *< .01* | | *0.62* | *0.65* | |
| Females | 25–77 years | 1981–84 | 1.50 | 1.9 | (1.5–2.3) | 64 | 97 | (58–136) |
| | | 1986–89 | 1.53 | 1.7 | (1.4–2.1) | 60 | 77 | (55–100) |
| | | 1991–94 | 1.68 | 2.4 | (1.9–3.0) | 53 | 86 | (56–116) |
| | | 1996–99 | 1.57 | 2.6 | (2.0–3.5) | 32 | 62 | (44–80) |
| | | *P (trend)* | *0.33* | *0.18* | | *0.06* | *0.15* | |

Notes: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 57.

### 6.2.2 Age-specific rates

The trends in IHD mortality and inequality by income were very similar to the trends for CVD, for both males and females. That is, relative inequalities increased for males in all ages and for females aged 45–59 years, but were stable for females aged 60–77 years. In contrast, absolute inequalities decreased among older females, but possibly peaked in the middle cohorts (ie, late 1980s or early 1990s) for males of all ages, and for females aged 45–59 years.

**Figure 11:** Ischaemic heart disease mortality rates, by income, sex and age




Notes: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 56. Rates for 25–44-year-olds are not shown due to imprecise mortality rates.

**Table 21:** Ischaemic heart disease relative and absolute measures of inequality, by income and age

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 45–59 years | 1981–84 | 1.21 | 1.3 | (1.1–1.7) | 58 | 87 | (58–116) |
| | | 1986–89 | 1.27 | 1.5 | (1.2–1.9) | 62 | 111 | (87–135) |
| | | 1991–94 | 1.72 | 2.7 | (2.0–3.8) | 110 | 176 | (144–209) |
| | | 1996–99 | 1.94 | 2.9 | (2.0–4.1) | 96 | 131 | (73–189) |
| | | *P (trend)* | *0.04* | *0.05* | | *0.25* | *0.18* | |
| | 60–77 years | 1981–84 | 1.34 | 1.5 | (1.3–1.7) | 404 | 559 | (441–678) |
| | | 1986–89 | 1.56 | 1.8 | (1.6–2.0) | 508 | 678 | (470–887) |
| | | 1991–94 | 1.59 | 2.0 | (1.7–2.3) | 413 | 635 | (545–724) |
| | | 1996–99 | 1.61 | 2.0 | (1.7–2.4) | 327 | 498 | (317–678) |
| | | *P (trend)* | *0.12* | *0.04* | | *0.28* | *0.93* | |
| Females | 45–59 years | 1981–84 | 1.46 | 1.6 | (1.0–2.5) | 31 | 32 | (-5–69) |
| | | 1986–89 | 2.39 | 5.3 | (2.2–12.9) | 52 | 84 | (58–111) |
| | | 1991–94 | 2.70 | 10.5 | (1.9–58.3) | 44 | 67 | (37–98) |
| | | 1996–99 | 2.84 | 9.2 | (1.7–48.1) | 34 | 51 | (36–67) |
| | | *P (trend)* | *0.07* | *0.06* | | *0.67* | *0.76* | |
| | 60–77 years | 1981–84 | 1.52 | 1.9 | (1.6–2.3) | 249 | 399 | (324–474) |
| | | 1986–89 | 1.46 | 1.7 | (1.4–2.0) | 211 | 301 | (239–364) |
| | | 1991–94 | 1.61 | 1.7 | (1.4–2.0) | 191 | 219 | (103–335) |
| | | 1996–99 | 1.46 | 1.9 | (1.5–2.4) | 103 | 176 | (75–277) |
| | | *P (trend)* | *0.96* | *0.80* | | *0.05* | *0.01* | |

Notes: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 57. Rates for 25–44-year-olds are not shown due to imprecise mortality rates.

## 6.3 Stroke

### 6.3.1 Age standardised rates (25–77 years)

As with IHD, stroke mortality rates halved overall from the early 1980s to late 1990s in both sexes and all income groups, although high-income groups showed slightly greater percentage improvements than low-income groups (57% compared with 53% for males; 66% compared with 56% for females).

Inequalities in stroke mortality were greatest among males in 1981–84, but there was no association of income with stroke mortality among females in 1981–84. No significant trends were noted for any measure of inequality in stroke mortality for either males or females.

**Figure 12:** Stroke mortality rates, ages 25–77 years, by income and sex


Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 58.

**Table 22:** Stroke relative and absolute measures of inequality, by income, 25–77-year-olds combined

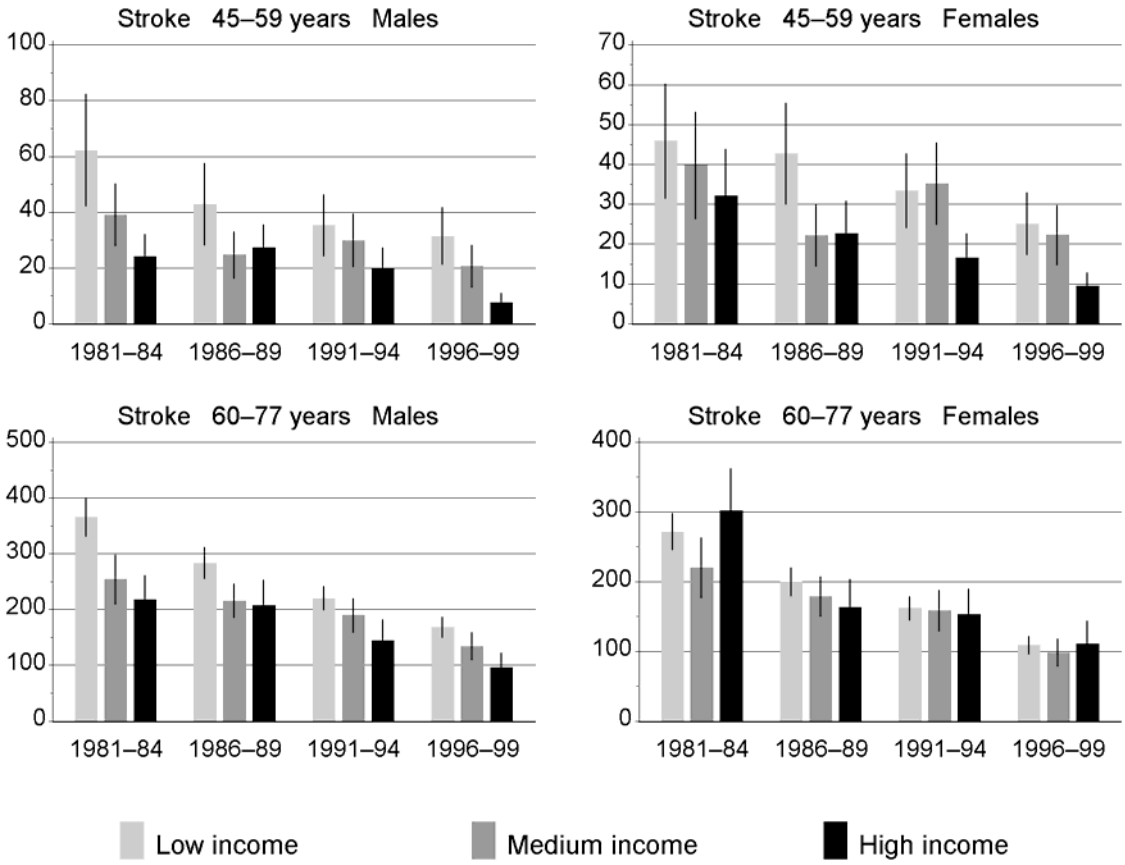
| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.78 | 2.4 | (1.7–3.4) | 42 | 57 | (23–92) |
| | | 1986–89 | 1.38 | 1.8 | (1.3–2.5) | 20 | 33 | (5–61) |
| | | 1991–94 | 1.60 | 2.5 | (1.7–3.7) | 22 | 39 | (29–49) |
| | | 1996–99 | 1.95 | 3.9 | (2.2–6.7) | 22 | 38 | (30–45) |
| | | *P (trend)* | *0.78* | *0.43* | | *0.33* | *0.51* | |
| Females | 25–77 years | 1981–84 | 0.92 | 0.9 | (0.7–1.3) | -7 | -4 | (-36–28) |
| | | 1986–89 | 1.30 | 1.6 | (1.2–2.2) | 13 | 24 | (14–33) |
| | | 1991–94 | 1.19 | 1.4 | (1.0–2.0) | 8 | 15 | (4–26) |
| | | 1996–99 | 1.18 | 1.5 | (1.0–2.3) | 5 | 11 | (5–18) |
| | | *P (trend)* | *0.37* | *0.33* | | *0.88* | *0.36* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 59.

### 6.3.2 Age specific rates

Stroke mortality rates tended to decrease among all income groups for both 45–59 and 60–77-year-old age groups.

**Figure 13:** Stroke mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 58. Rates for 25–44-year-olds were too statistically imprecise to present.

Among 45–59-year-old females there were widening relative inequalities but stable absolute inequalities. There was no association of income with stroke mortality in 60–77-year-old females. People aged 45–59 years in 1981–84 were aged 60–77 years in 1996–99. Hence these results suggest that, for females, the association of stroke mortality that was present for this birth cohort when they were 45–59 years old had disappeared by the time they reached 60–77 years. This was not the case for males, for whom an association between low income and high stroke mortality was observed for both age groups.

# Chapter 7: Chronic Lung Disease

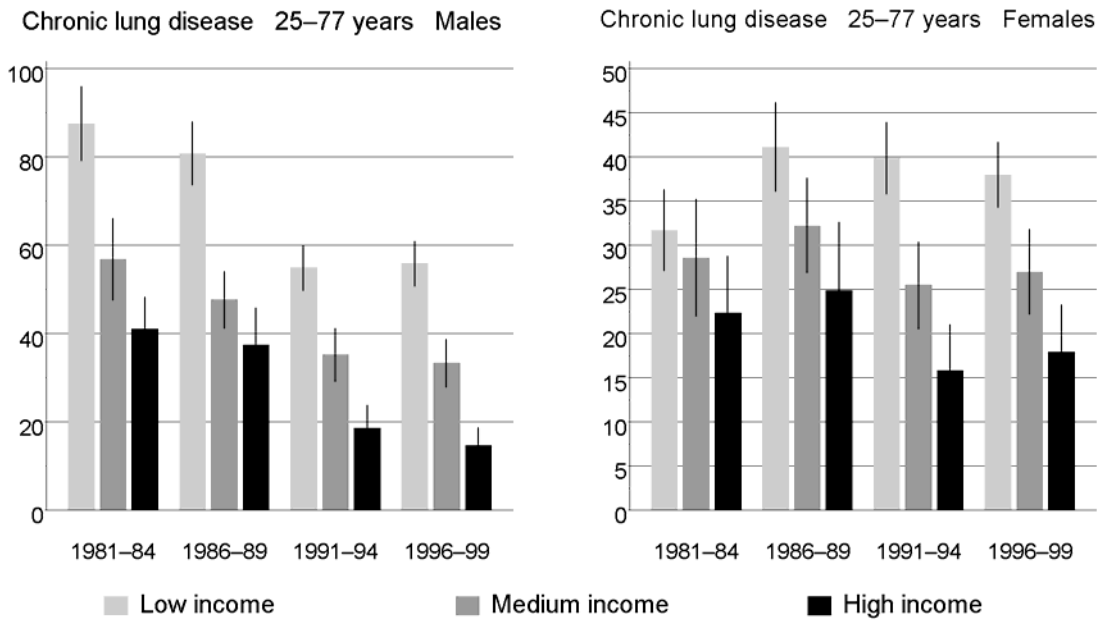
For guidance on the inequality measures used, see 'Guide to understanding trends in SRDs, SRRs, SIIs, and RIIs' (page 23).

Chronic lung disease mortality comprises mainly deaths due to chronic obstructive pulmonary disease (chronic bronchitis and emphysema), together with a relatively small number of deaths caused by asthma.

## 7.1 Age-standardised rates (25–77 years)

Chronic lung disease mortality was strongly patterned by income at all times and for both sexes. For males the rates decreased over time among all income groups such that absolute inequalities by income remained stable over time, yet relative inequalities widened. Among females, trends in rates over time were more erratic, although possibly tending to decrease from 1986–89. The SRR (comparing low- to high-income groups) increased from 2.13 to 3.82 among males, and from 1.42 to 2.13 among females. The RIIs were unstable due to low rates in the high-income groups, but were consistent with a strong increasing trend in relative inequalities.

**Figure 14:** Chronic lung disease mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 60.

## 7.2 Age-specific rates

Among males, trends were similar for both middle (45–59 years) and older (60–77 years) age groups, resembling the age-standardised pattern presented above.

Among females aged 45–59 years, mortality rates decreased in all income groups. However, among 60–77-year-old females rates *increased* among the low-income group, possibly increased in the medium-income group, but did not change among the high-income group. Consequently, both absolute and relative gaps widened significantly among 60–77-year-old females over the observation period (Appendix, Table 61).

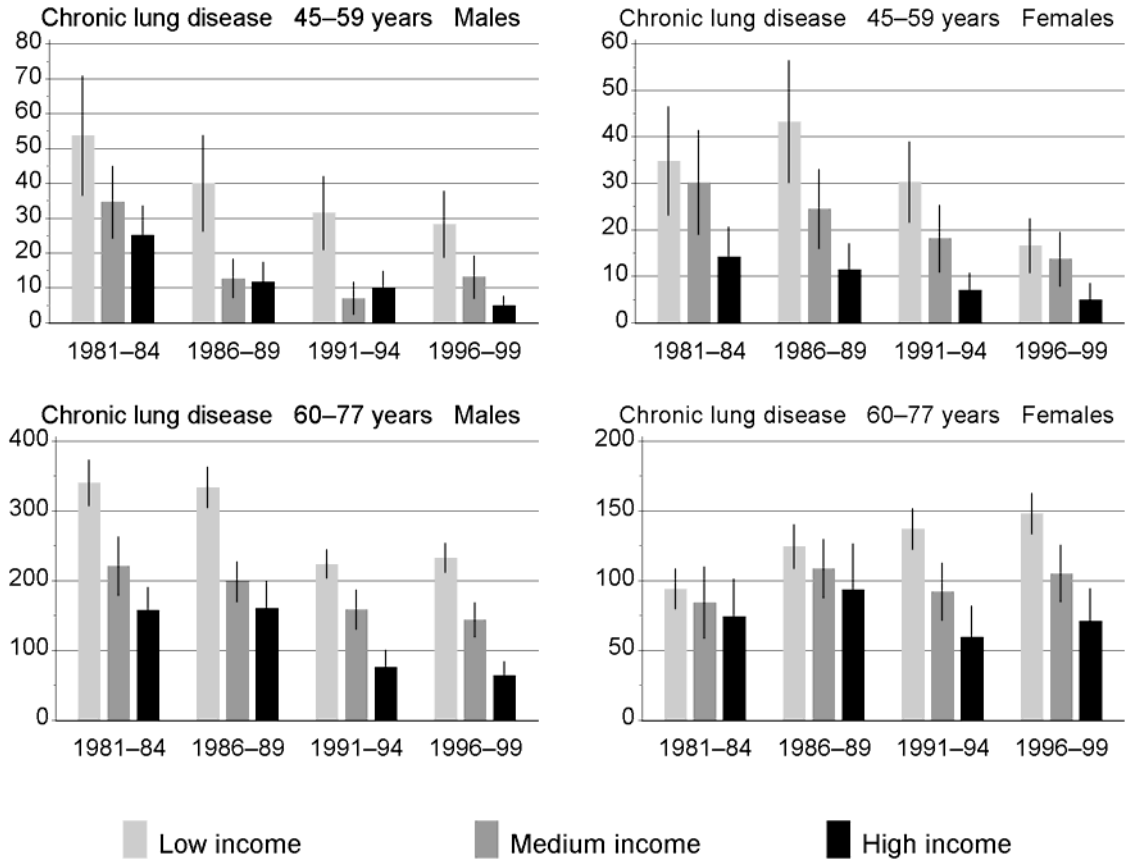
**Table 23:** Chronic lung disease relative and absolute measures of inequality, by income, 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 2.13 | 3.5 | (2.3–5.5) | 47 | 65 | (32–99) |
| | | 1986–89 | 2.16 | 4.0 | (2.5–6.3) | 43 | 64 | (38–89) |
| | | 1991–94 | 2.96 | 11.0 | (3.4–35.4) | 36 | 57 | (41–73) |
| | | 1996–99 | 3.82 | * | | 41 | 65 | (40–90) |
| | | *P (trend)* | *0.06* | * | | *0.50* | *0.78* | |
| Females | 25–77 years | 1981–84 | 1.42 | 2.3 | (1.4–3.8) | 9 | 20 | (4–37) |
| | | 1986–89 | 1.65 | 2.2 | (1.4–3.4) | 16 | 25 | (19–32) |
| | | 1991–94 | 2.52 | 6.2 | (2.8–13.8) | 24 | 41 | (33–49) |
| | | 1996–99 | 2.13 | 3.7 | (2.1–6.5) | 20 | 32 | (28–36) |
| | | *P (trend)* | *0.21* | *0.29* | | *0.21* | *0.46* | |

Notes: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 61.

* The RII for males in 1996–99 became very large and unstable due to an estimated chronic lung disease mortality rate of near-zero at the highest income. Accordingly, this estimate and the trend value have been omitted. However, it is undeniable that relative inequalities in male chronic lung disease increased notably during the 1980s and 1990s.

**Figure 15:** Chronic lung disease mortality rates, by income, sex and age




Notes: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 60. Rates for 25–44-year-olds were too statistically imprecise to present.

# Chapter 8: Cancer

For guidance on the inequality measures used, see 'Guide to understanding trends in SRDs, SRRs, SIIs, and RIIs' (page 23).

There are many different types of cancer, with varying causes and treatments. Consequently, social patterns – including inequalities in mortality – might be expected to vary by cancer site.

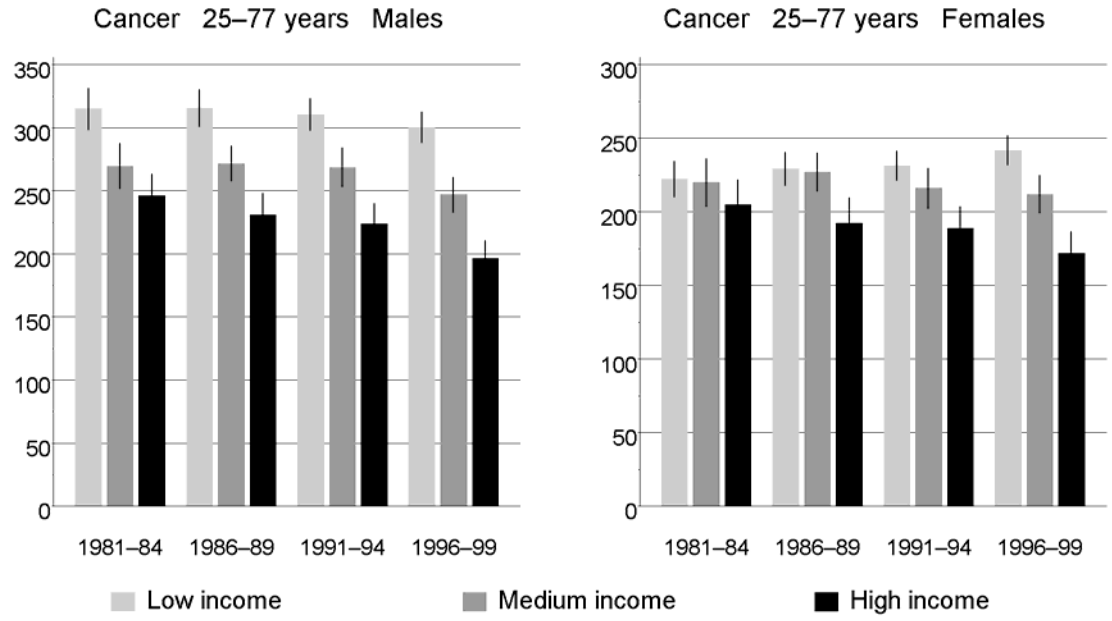
We have selected four specific cancers for analysis in this report: lung, colorectal, breast and prostate. Together these cancers make up about half of total cancer mortality in the study age group of 25–77 years. We also present results in this chapter for non-lung cancers combined as a proxy for cancers not strongly associated with tobacco. Minor cancer sites could not be included because of small numbers of deaths by income group, even using the large cohorts provided by the NZCMS. To begin with, however, we present results for all cancers combined.

## 8.1 All cancers combined

### 8.1.1 Age-standardised rates (25–77 years)

Among males, all income groups enjoyed decreasing total cancer mortality rates over time, although the decrease was larger for the high-income group. Among females, the low-income group actually had *increasing* mortality rates over time, while the middle-income group experienced stable rates and only the high-income group showed decreasing rates.

**Figure 16:** Total cancer mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 62.

As a consequence of these diverging trends in total cancer mortality, both absolute and relative inequalities increased over time (Table 24). In absolute terms, the SRD increased from 69 per 100,000 to 104 per 100,000 while the SII increased from 104 per 100,000 to 163 per 100,000 among males. Corresponding increases among females, from 18 to 70 and 32 to 122 per 100,000, respectively, were proportionately larger (approximately four-fold increases compared to less than two-fold increases among males).

For males, the SRR increased from 1.28 to 1.53 over the study period (p for trend 0.04), while the RII increased even more from 1.5 to 2.0 (p for trend 0.04). Corresponding relative inequality among females were SRRs from 1.09 to 1.41 and RIIs from 1.2 to 1.8.

**Table 24:** Total cancer relative and absolute measures of inequality, by income, 25–77-year-olds combined

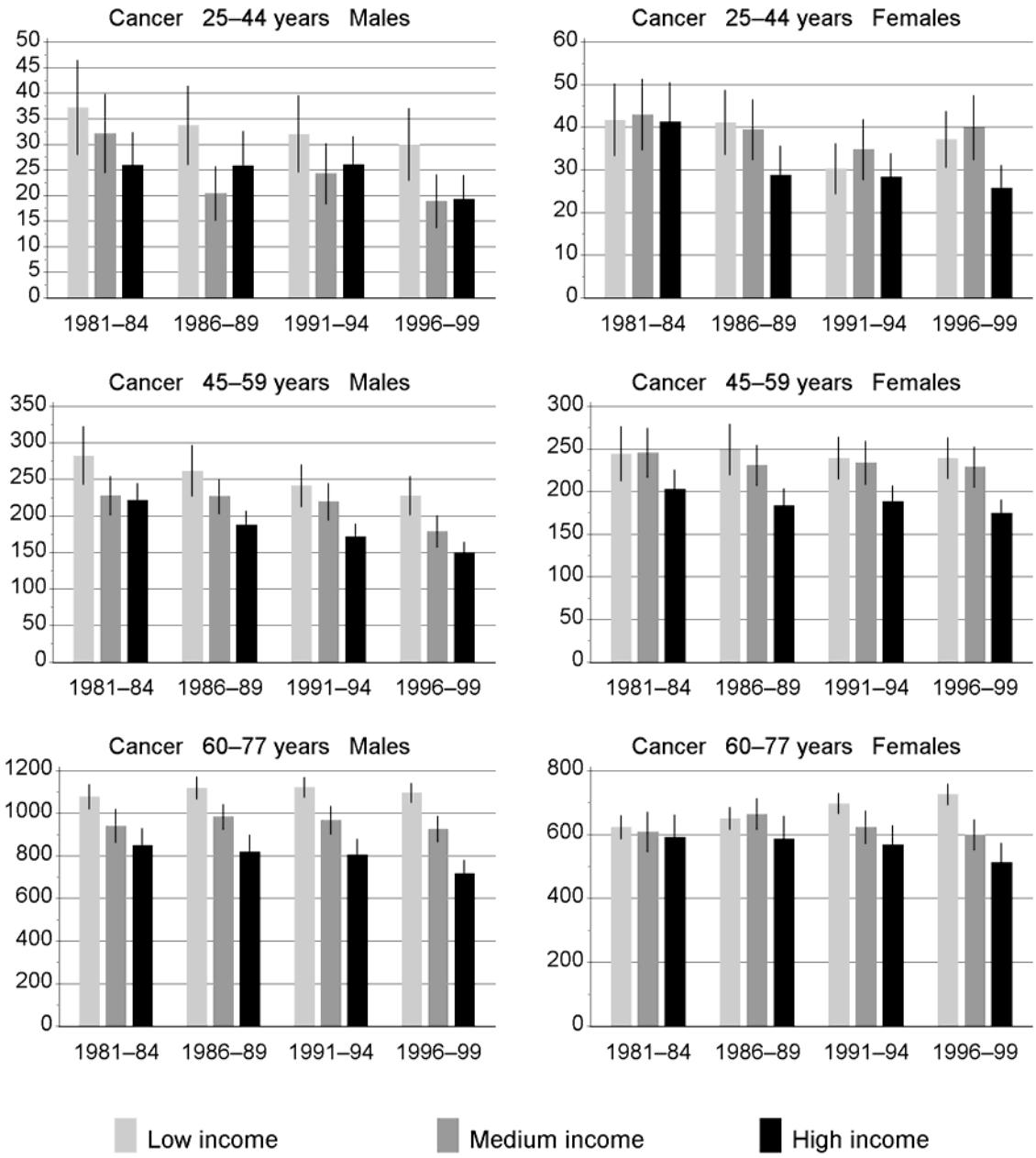
| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.28 | 1.5 | (1.3–1.7) | 69 | 104 | (76–131) |
| | | 1986–89 | 1.37 | 1.5 | (1.3–1.7) | 85 | 107 | (75–140) |
| | | 1991–94 | 1.39 | 1.8 | (1.6–2.1) | 87 | 149 | (118–180) |
| | | 1996–99 | 1.53 | 2.0 | (1.8–2.3) | 104 | 163 | (144–182) |
| | | *P (trend)* | *0.04* | *0.04* | | *0.03* | *0.03* | |
| Females | 25–77 years | 1981–84 | 1.09 | 1.2 | (1.0–1.3) | 18 | 32 | (-3–66) |
| | | 1986–89 | 1.19 | 1.3 | (1.1–1.5) | 37 | 53 | (19–87) |
| | | 1991–94 | 1.23 | 1.4 | (1.2–1.6) | 43 | 70 | (63–78) |
| | | 1996–99 | 1.41 | 1.8 | (1.6–2.1) | 70 | 122 | (94–150) |
| | | *P (trend)* | *0.04* | *0.04* | | *0.03* | *0.10* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 63.

### 8.1.2 Age-specific rates

A visual inspection of Figure 17 below demonstrates that widening inequalities in total cancer mortality (both absolute and relative) were present in the 45–59-year old-and the 60–77-year-old age groups for both sexes, although most notably for females aged 60–77 years. Patterns among 25–44-year-olds are imprecise due to cancer mortality being rare among young adults. Of note, whereas relative inequalities in CVD mortality by income were greatest among 45–59-year-olds, relative inequalities in cancer mortality were equally strong in 45–59 and 60–77-year-olds.

**Figure 17:** Total cancer mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 62.

**Table 25:** Total cancer relative and absolute measures of inequality, by income and age

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 45–59 years | 1981–84 | 1.28 | 1.5 | (1.2–2.0) | 62 | 95 | (46–144) |
| | | 1986–89 | 1.40 | 1.8 | (1.4–2.3) | 74 | 123 | (72–174) |
| | | 1991–94 | 1.41 | 1.9 | (1.5–2.5) | 70 | 127 | (92–162) |
| | | 1996–99 | 1.52 | 1.9 | (1.5–2.5) | 78 | 109 | (69–150) |
| | | *P (trend)* | *0.04* | *0.13* | | *0.18* | *0.65* | |
| | 60–77 years | 1981–84 | 1.27 | 1.5 | (1.3–1.7) | 229 | 367 | (298–436) |
| | | 1986–89 | 1.36 | 1.5 | (1.3–1.7) | 299 | 413 | (309–518) |
| | | 1991–94 | 1.40 | 1.5 | (1.4–1.7) | 318 | 422 | (220–624) |
| | | 1996–99 | 1.53 | 1.7 | (1.5–2.0) | 378 | 512 | (348–676) |
| | | *P (trend)* | *0.02* | *0.10* | | *0.02* | *0.02* | |
| Females | 45–59 years | 1981–84 | 1.20 | 1.5 | (1.2–1.9) | 41 | 90 | (58–121) |
| | | 1986–89 | 1.36 | 1.6 | (1.3–2.0) | 66 | 98 | (72–124) |
| | | 1991–94 | 1.27 | 1.4 | (1.2–1.8) | 51 | 78 | (26–129) |
| | | 1996–99 | 1.37 | 1.8 | (1.5–2.3) | 65 | 119 | (97–140) |
| | | *P (trend)* | *0.32* | *0.39* | | *0.38* | *0.19* | |
| | 60–77 years | 1981–84 | 1.05 | 1.1 | (0.9–1.3) | 32 | 47 | (-37–130) |
| | | 1986–89 | 1.11 | 1.1 | (1.0–1.3) | 63 | 76 | (-29–182) |
| | | 1991–94 | 1.23 | 1.3 | (1.2–1.5) | 129 | 189 | (168–210) |
| | | 1996–99 | 1.42 | 1.6 | (1.4–1.9) | 213 | 313 | (263–364) |
| | | *P (trend)* | *0.03* | *0.03* | | *0.02* | *0.03* | |

Notes: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 63. Inequality measures for 25–44-year-olds were too statistically imprecise to present.

## 8.2 Lung cancer

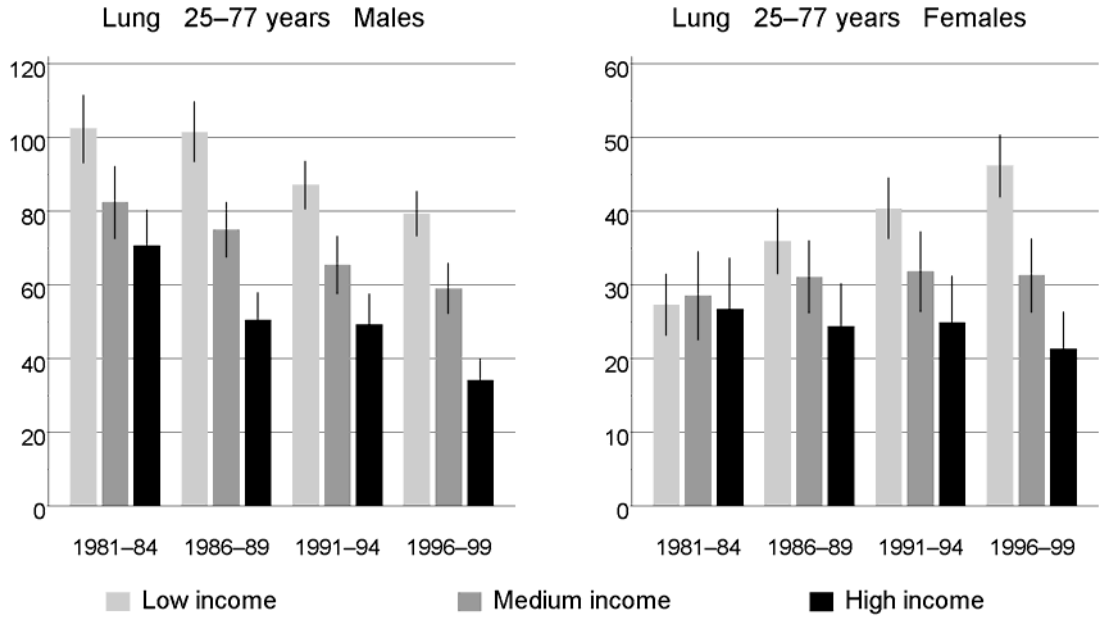
### 8.2.1 Age-standardised rates (25–77 years)

Lung cancer mortality rates (standardised across the 25–77 years age range) decreased from 1981–84 to 1996–99 within each income level among males (Figure 18). These decreases were statistically significant in each of the three income groups, but were largest among the high-income group (37 per 100,000 or 52%) and lowest among the low-income group (23 per 100,000 or 22%).

The trends were different among females. Rates decreased among the high-income group, but only modestly (5 per 100,000 or 20%). Among the middle-income group lung cancer mortality rates showed no change. But among the low-income female group, rates *increased* by 19 per 100,000, a 69% increase. (This pattern is similar to that presented in Chapter 7 for chronic lung disease.)

These divergent trends in mortality rates by income produced large monotonic increases in lung cancer inequality by income among females, on both relative and absolute scales (Table 26). In absolute terms, the SRD increased from 1 to 25 per 100,000 over the observation period, while the SII increased from 3 to 40 per 100,000. In relative terms, the SRR increased from 1.02 to 2.17 while the RII increased from 1.1 to 3.9. Thus inequality in female lung cancer mortality by income only emerged in the mid-1980s and has increased dramatically since then, in both absolute and relative terms.

**Figure 18:** Lung cancer mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 64.

Absolute inequalities in lung cancer mortality at any one point in time were greater among males than among females. However, there has been little change in male absolute inequalities since 1986–89. Relative inequalities among males also tended to be greater than among females at any point in time, and increased over time.

**Table 26:** Lung cancer relative and absolute measures of inequality, by income, 25–77-year-olds combined

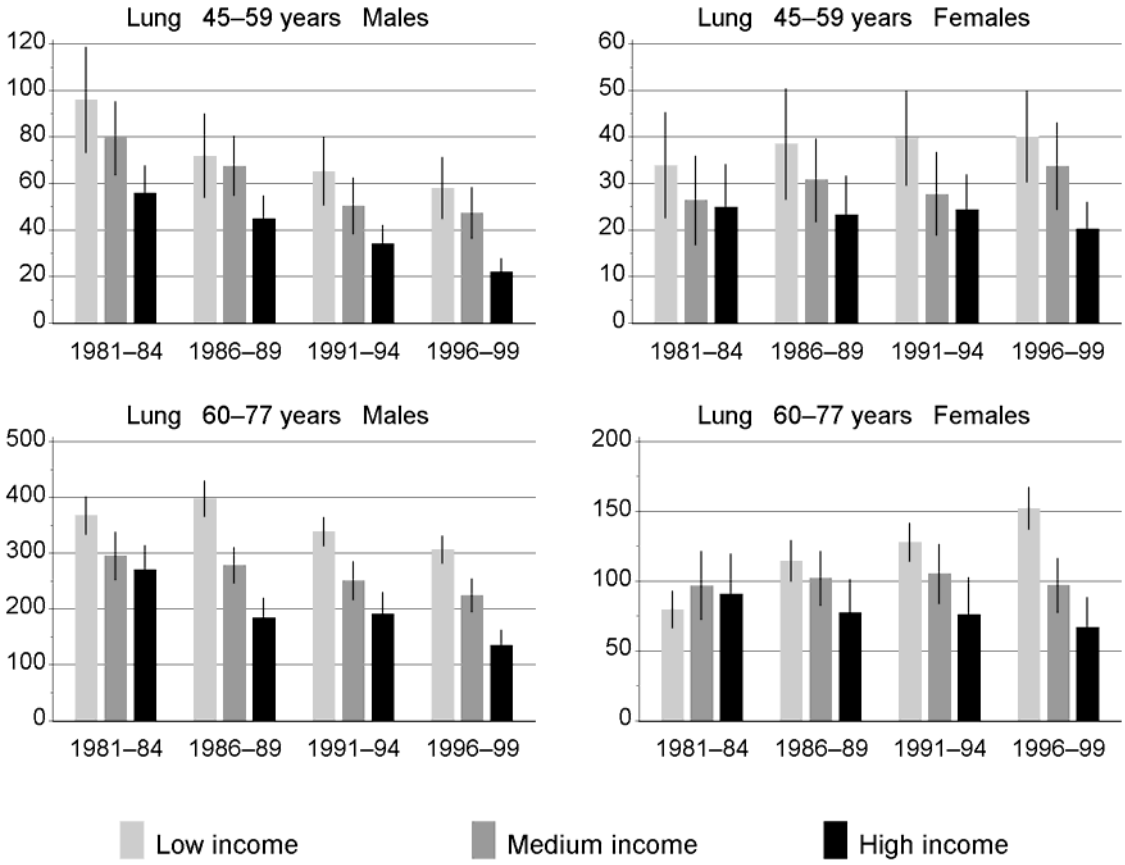
| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.45 | 1.8 | (1.4–2.3) | 32 | 47 | (39–55) |
| | | 1986–89 | 2.02 | 3.3 | (2.4–4.5) | 51 | 79 | (59–98) |
| | | 1991–94 | 1.77 | 2.7 | (1.9–3.9) | 38 | 60 | (49–72) |
| | | 1996–99 | 2.33 | 5.1 | (3.3–8.0) | 45 | 73 | (62–84) |
| | | *P (trend)* | *0.16* | *0.14* | | *0.65* | *0.18* | |
| Females | 25–77 years | 1981–84 | 1.02 | 1.1 | (0.7–1.8) | 1 | 3 | (-6–13) |
| | | 1986–89 | 1.48 | 1.9 | (1.3–2.8) | 12 | 19 | (7–30) |
| | | 1991–94 | 1.62 | 2.4 | (1.5–3.7) | 16 | 27 | (23–30) |
| | | 1996–99 | 2.17 | 3.9 | (2.4–6.3) | 25 | 40 | (30–49) |
| | | *P (trend)* | *0.02* | *0.01* | | *0.01* | *< .01* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 65.

### 8.2.2 Age-specific rates

Lung cancer mortality rates are largely driven by the oldest age group (60–77 years). Trends in this age group are similar to the overall pattern described above. However, the same trends are also evident among the middle age group (45–59 years). SRRs and SRDs by age are presented in the Appendix, Table 65.

**Figure 19:** Lung cancer mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 64. Rates for 25–44-year-olds were too statistically imprecise to present.

## 8.3 Colorectal cancer

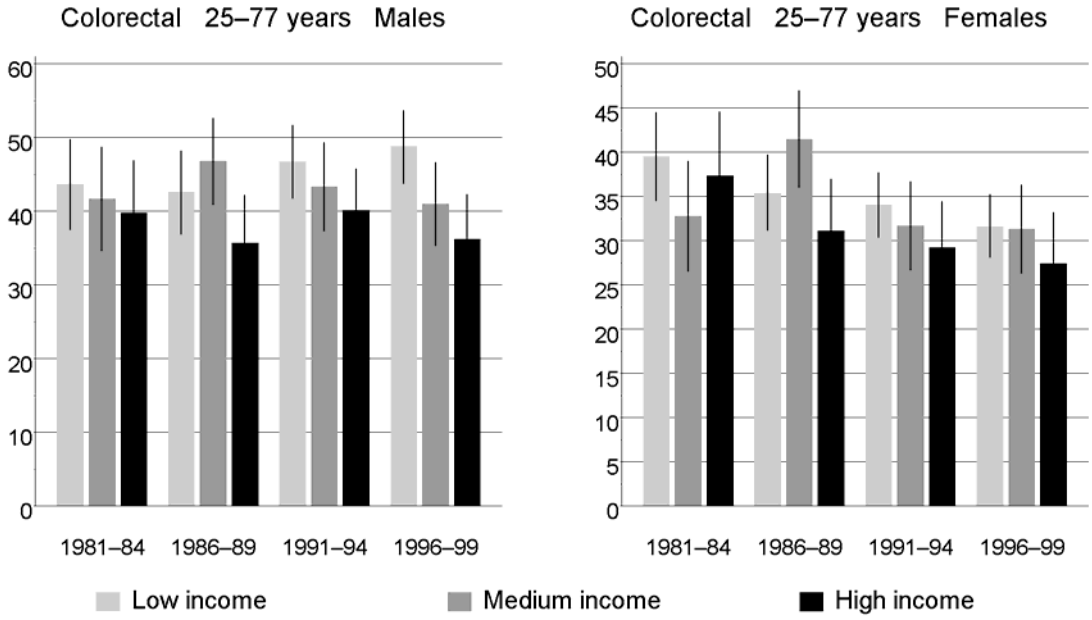
### 8.3.1 Age-standardised rates (25–77 years)

Female colorectal cancer mortality rates decreased slightly during the 1980s and 1990s among all income groups. By contrast, rates among males increased modestly in the low-income group (44 to 49 per 100,000, p for trend 0.06) while remaining stable in the middle- and high-income groups.

These gradual trends in colorectal cancer mortality have resulted in widening of both absolute and relative inequalities in mortality by income. In absolute terms, both the SRD and SII increased: from 4 to 13 and from 8 to 23 per 100,000 respectively, among males, and from 2 to 4 and from 1 to 9 per 100,000 respectively, among females.

In relative terms, the SRR increased from 1.10 to 1.35 among males and from 1.06 to 1.15 among females. The RII increases were more pronounced: 1.2 to 1.8 for males and 1.0 to 1.4 for females. The p values for trend in the SRRs and RIIs were all 0.20 or less and the (modest) differences in colorectal cancer mortality by income tended to increase with each subsequent cohort, pointing to a likely true increase in relative inequalities over time.

**Figure 20:** Colorectal cancer mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 66.

**Table 27:** Colorectal cancer relative and absolute measures of inequality, by income, 25–77-year-olds combined

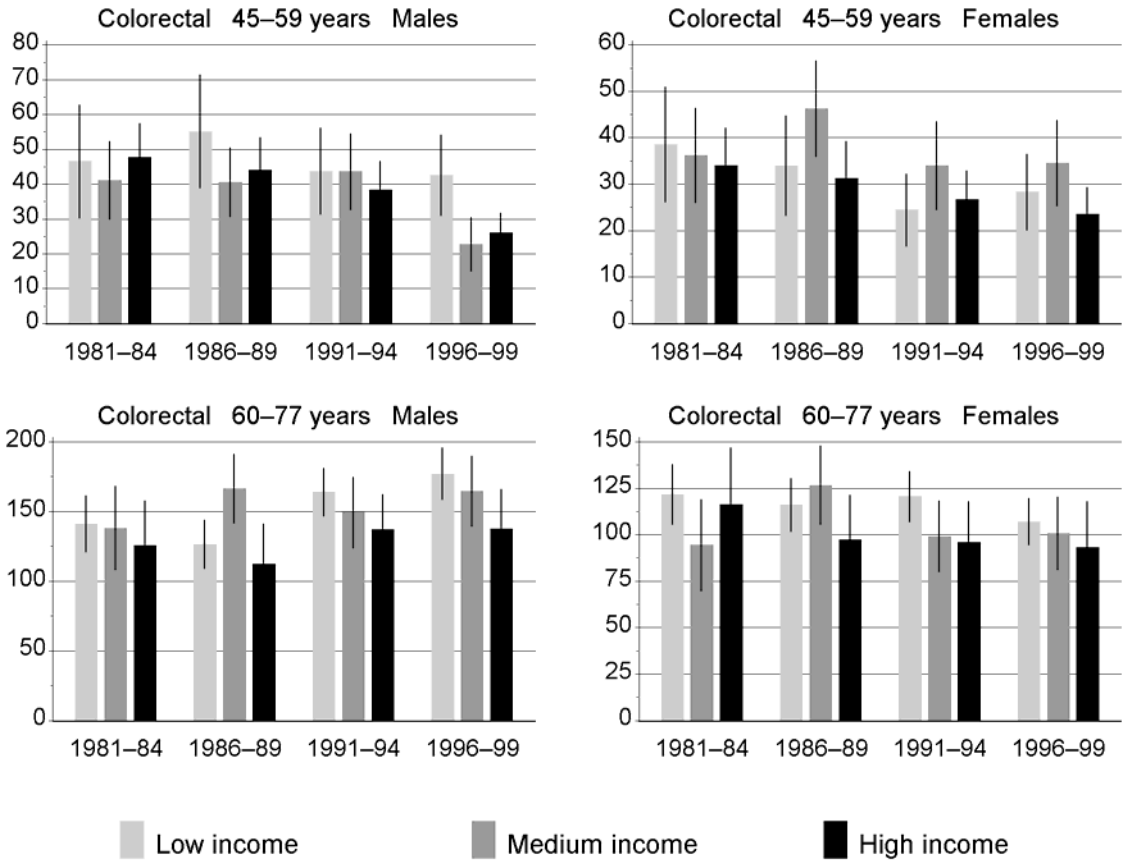
| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.10 | 1.2 | (0.9–1.7) | 4 | 8 | (-10–25) |
| | | 1986–89 | 1.19 | 1.1 | (0.7–1.6) | 7 | 3 | (-4–10) |
| | | 1991–94 | 1.16 | 1.5 | (1.1–1.9) | 7 | 16 | (-2–34) |
| | | 1996–99 | 1.35 | 1.8 | (1.3–2.5) | 13 | 23 | (14–32) |
| | | *P (trend)* | *0.16* | *0.12* | | *0.10* | *0.09* | |
| Females | 25–77 years | 1981–84 | 1.06 | 1.0 | (0.7–1.5) | 2 | 1 | (-17–19) |
| | | 1986–89 | 1.14 | 1.1 | (0.8–1.4) | 4 | 2 | (-8–12) |
| | | 1991–94 | 1.17 | 1.2 | (0.9–1.7) | 5 | 6 | (-1–13) |
| | | 1996–99 | 1.15 | 1.4 | (1.0–1.9) | 4 | 9 | (2–17) |
| | | *P (trend)* | *0.20* | *0.02* | | *0.38* | *0.01* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 67.

### 8.3.2 Age-specific rates

Trends were similar among 45–59 and 60–77-year-olds. The SRD and SRR estimates by age are presented in the Appendix, Table 67.

**Figure 21:** Colorectal cancer mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 66. Rates for 25–55-year-olds were too statistically imprecise to present.

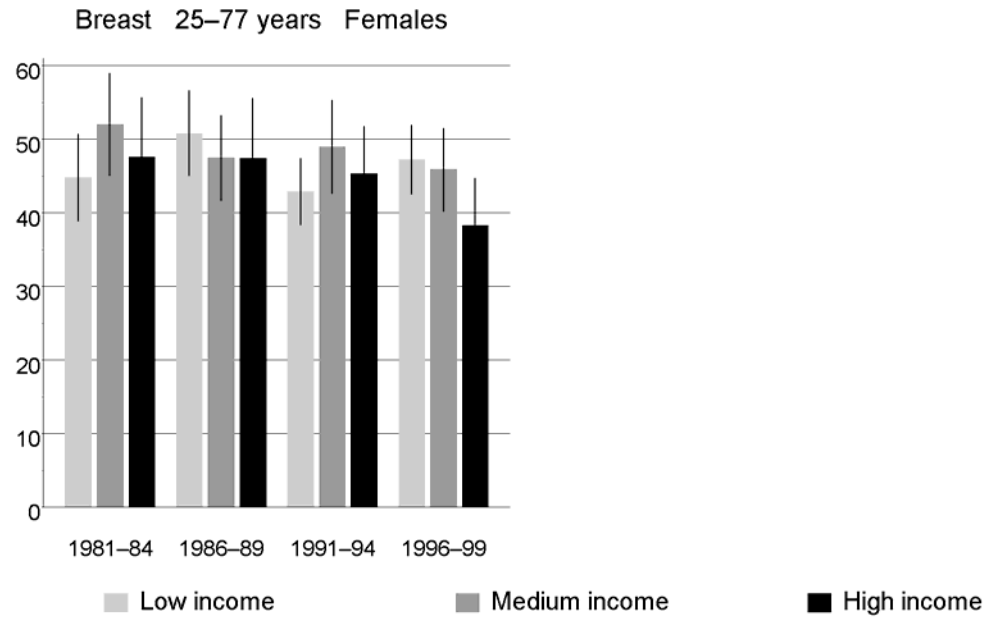
## 8.4 Breast cancer

### 8.4.1 Age-standardised rates (25–77 years)

Breast cancer mortality rates for women aged 25–77 years did not change notably over the 1980s and 1990s, with the exception of a possible small decrease from 48 to 38 per 100,000 among the high-income group (p for trend 0.11).

If there was any association of income with breast cancer mortality, then it was only during 1996–99. In this cohort, the SRR was 1.23 (95% CI 1.01 to 1.50) and the RII was 1.5 (95% CI 1.1 to 1.9); the SRD was 9 per 100,000 (95% CI 1 to 17) and the SII was 16 per 100,000 (95% CI -3 to 36).

**Figure 22:** Breast cancer mortality rates, ages 25–77 years, by income




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 68.

**Table 28:** Breast cancer relative and absolute measures of inequality, by income, 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Females | 25–77 years | 1981–84 | 0.94 | 1.0 | (0.7–1.3) | -3 | -2 | (-13–10) |
| | | 1986–89 | 1.07 | 1.1 | (0.9–1.5) | 3 | 6 | (3–10) |
| | | 1991–94 | 0.95 | 0.9 | (0.7–1.2) | -2 | -4 | (-17–9) |
| | | 1996–99 | 1.23 | 1.5 | (1.1–1.9) | 9 | 16 | (-3–36) |
| | | *P (trend)* | *0.32* | *0.38* | | *0.32* | *0.66* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 69.

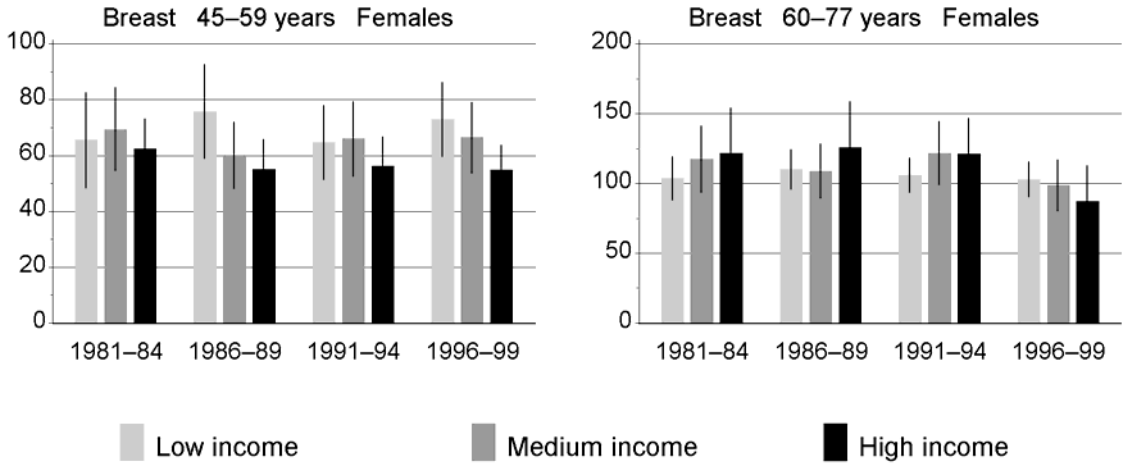
### 8.4.2 Age-specific rates

Although statistically imprecise, there is a possible trend in age-specific rates that may be important in light of both the age-standardised analysis described above and international research demonstrating the possible emergence of socioeconomic inequalities in breast cancer incidence and mortality in recent decades (Martikainen and Valkonen 2000; Dano et al 2003).

Breast cancer mortality among middle-aged females (45–59 years) was higher among low-income females from the late 1980s, but among older women (60–77 years) such a pattern only appeared in 1996–99. (Prior to 1996–99, breast cancer mortality among 60–77-year-olds was actually higher among high-income women.) While 95% confidence intervals include the null for nearly all SRR and SRD estimates (Appendix, Table 69), this pattern might point to an emerging inverse socioeconomic gradient in breast cancer mortality, possibly related to the

cohort of women born around 1930. (Note: The age categories used in this report are not ideal for breast cancer research, and further work is required.)

**Figure 23:** Breast cancer mortality rates, by income and age

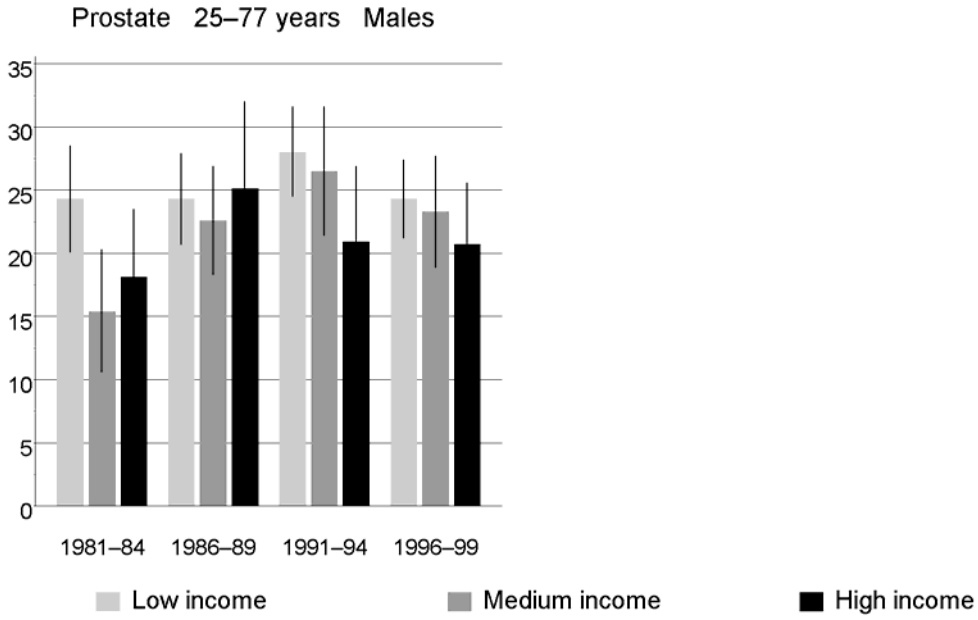



Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 68. Rates for 25–44-year-olds were too statistically imprecise to present.

## 8.5 Prostate cancer

The NZCMS is not an ideal study design for analysing prostate cancer as the upper age limit for deaths was 77 years. Nevertheless, there was an association of lower income with higher prostate cancer mortality for three out of the four census cohorts (Figure 24 and Table 29). There were no clear trends over time.

**Figure 24:** Prostate cancer mortality rates, ages 25–77 years, by income




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 70.

**Table 29:** Prostate cancer relative and absolute measures of inequality, by income, 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.34 | 1.4 | (0.8–2.4) | 6 | 6 | (-2–14) |
| | | 1986–89 | 0.97 | 0.8 | (0.5–1.4) | -1 | -4 | (-12–4) |
| | | 1991–94 | 1.34 | 1.7 | (1.1–2.7) | 7 | 12 | (3–22) |
| | | 1996–99 | 1.17 | 1.2 | (0.8–1.9) | 4 | 5 | (-4–14) |
| | | *P (trend)* | *0.93* | *0.81* | | *0.94* | *0.77* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 71.

No age-specific prostate cancer analyses are presented because few prostate cancer deaths occur in younger ages.

## 8.6 Non-lung cancer

Lung cancer incidence is largely driven by tobacco smoking. Tobacco smoking is also associated, albeit less strongly, with other cancers such as those of the kidney, oesophagus, pancreas and bladder. Nevertheless, a combined analysis of non-lung cancers is useful to determine overall social patterns and trends in cancers that do not have smoking as the major determinant.

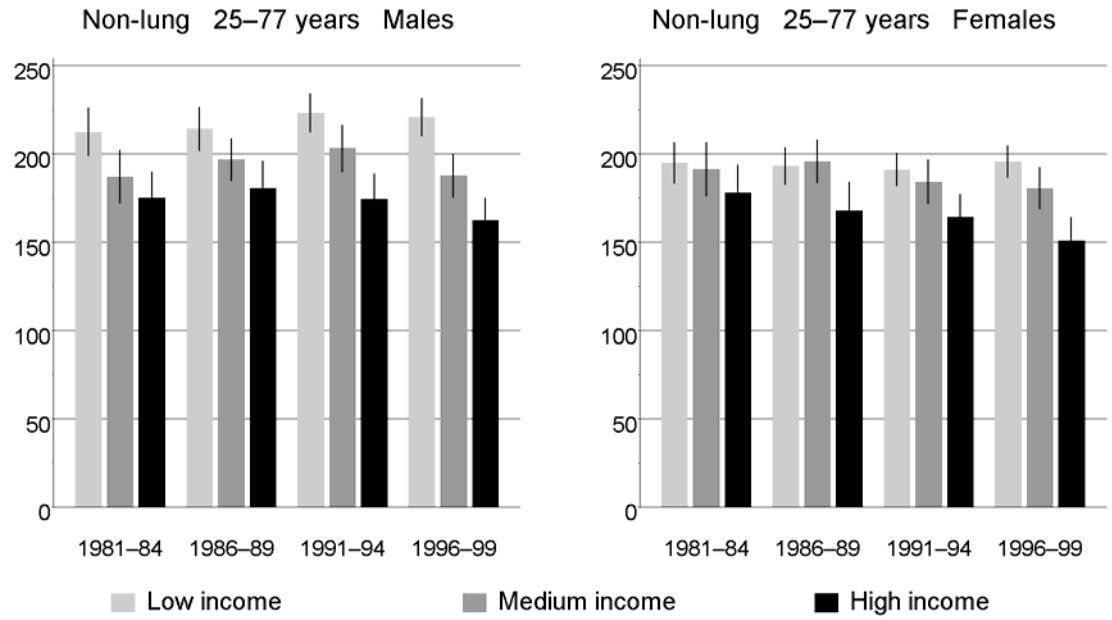
### 8.6.1 Age-standardised rates (25–77 years)

Non-lung cancer mortality rates were stable for low and medium income groups, but fell by 15% (females) and 7% (males) for the high-income group. As a result, the absolute gap in non-lung cancer between the low and high income groups approximately doubled for males and tripled for females between 1981–84 and 1996–99 (SRD and SII estimates in Table 30 below).

At the same time, relative differences increased from an SRR of 1.21 to 1.36 for males, and from 1.10 to 1.30 for females (p for trend both < 0.10). Corresponding increases in RII were from 1.4 to 1.6 for males, and from 1.2 to 1.6 for females.

While these relative inequalities in non-lung cancer are not as large as those for other causes of death, the fact that cancer is a major cause of mortality means that these (widening) inequalities are major drivers of widening inequalities in all-cause mortality (as is further examined in Chapter 12).

**Figure 25:** Non-lung cancer mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 72.

**Table 30:** Non-lung cancer relative and absolute measures of inequality by income, 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.21 | 1.4 | (1.2–1.6) | 37 | 57 | (35–78) |
| | | 1986–89 | 1.19 | 1.2 | (1.0–1.4) | 34 | 29 | (-7–64) |
| | | 1991–94 | 1.28 | 1.6 | (1.4–1.8) | 49 | 89 | (54–124) |
| | | 1996–99 | 1.36 | 1.6 | (1.4–1.9) | 58 | 90 | (82–98) |
| | | *P (trend)* | *0.08* | *0.26* | | *0.08* | *0.14* | |
| Females | 25–77 years | 1981–84 | 1.10 | 1.2 | (1.0–1.4) | 17 | 28 | (-1–57) |
| | | 1986–89 | 1.15 | 1.2 | (1.0–1.4) | 25 | 34 | (4–65) |
| | | 1991–94 | 1.16 | 1.3 | (1.1–1.5) | 27 | 44 | (35–53) |
| | | 1996–99 | 1.30 | 1.6 | (1.4–1.9) | 45 | 82 | (45–120) |
| | | *P (trend)* | *0.09* | *0.10* | | *0.07* | *0.19* | |

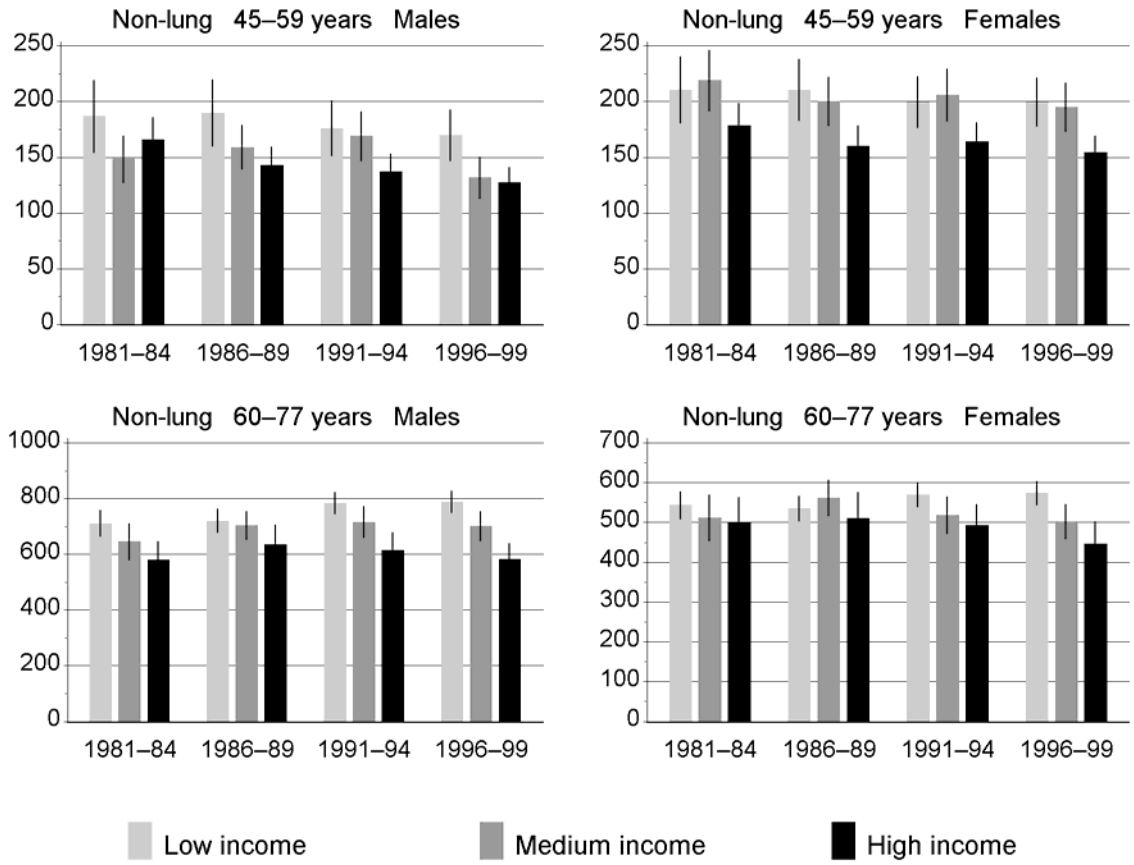
Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 73.

### 8.6.2 Age-specific rates

Trends in the pattern of non-cancer mortality vary by age group. Among 45–59-year-olds, non-lung cancer mortality rates have remained stable over time for the low- and middle-income groups, but have decreased for the high-income group. Among 60–77-year-olds, in contrast, the non-lung cancer mortality rates have increased over time for the low-income group, but have

remained stable for the medium- and high-income group. Nevertheless, the net result is increasing SRDs and SRRs in both age groups (Appendix, Table 73).

**Figure 26:** Non-lung cancer mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 72. Rates for 25–44-year-olds were too statistically imprecise to present.

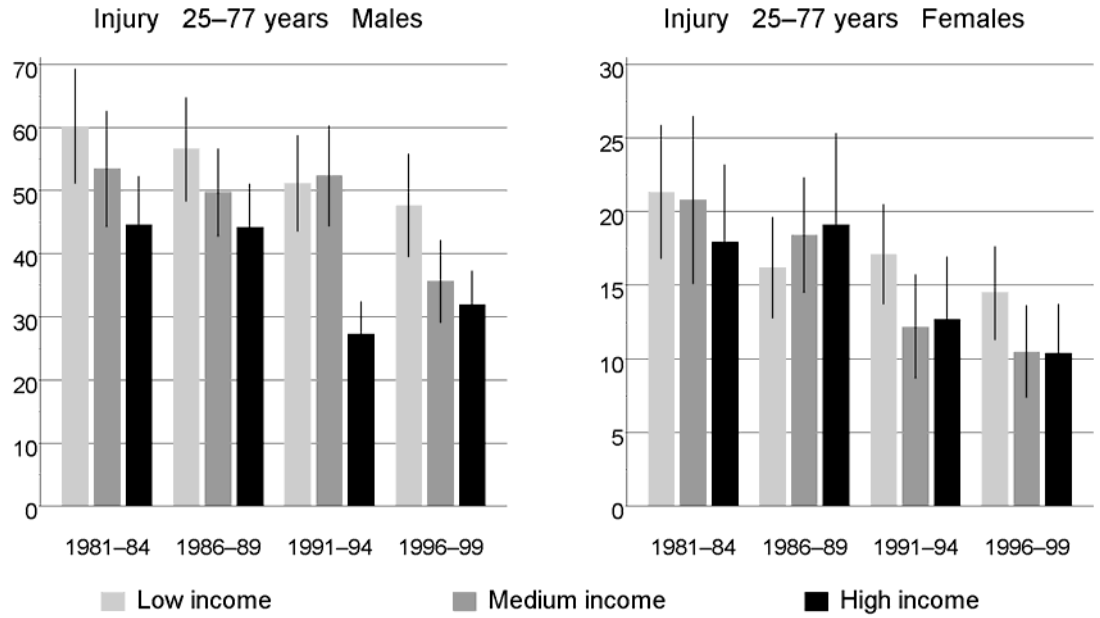
# Chapter 9: Unintentional Injury

For guidance on the inequality measures used, see 'Guide to understanding trends in SRDs, SRRs, SIIs, and RIIs' (page 23).

## 9.1 Age-standardised rates (25–77 years)

Unintentional injury mortality rates decreased over time for all income groups in both sexes. The percentage decrease from 1981–84 to 1996–99 among males was greatest (28%) in the high-income group and lowest in the low-income group (21%). Likewise, among females the rate decreased more among the high-income (42%) than the low-income group (32%).

**Figure 27:** Unintentional injury mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 74.

The absolute differences by income (SRDs and SIIs) among females were small, with 95% confidence intervals that included the null – except the SII in 1996–99 (8 per 100,000, 95% CI 5 to 12 per 100,000). That is, consistent with a visual inspection of Figure 27, there was no consistently strong association of income with unintentional injury mortality. However, in three out of the four cohorts there was some apparent excess risk of female unintentional injury mortality among the low-income group.

Among males, the SRDs and SIIs were consistently greater than 1.0, with 95% confidence intervals that excluded the null. There was no apparent trend over time in the absolute inequalities among males.

**Table 31:** Unintentional injury relative and absolute measures of inequality, by income, 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.35 | 1.8 | (1.3–2.6) | 16 | 30 | (23–37) |
| | | 1986–89 | 1.28 | 1.5 | (1.1–2.0) | 12 | 18 | (9–28) |
| | | 1991–94 | 1.88 | 2.8 | (1.8–4.4) | 24 | 40 | (13–67) |
| | | 1996–99 | 1.49 | 1.9 | (1.3–2.9) | 16 | 24 | (16–31) |
| | | *P (trend)* | *0.50* | *0.59* | | *0.73* | *0.61* | |
| Females | 25–77 years | 1981–84 | 1.19 | 1.5 | (0.9–2.7) | 4 | 8 | (-1–18) |
| | | 1986–89 | 0.85 | 0.9 | (0.5–1.5) | -3 | -2 | (-7–3) |
| | | 1991–94 | 1.35 | 1.6 | (0.9–2.8) | 4 | 6 | (-1–14) |
| | | 1996–99 | 1.39 | 2.1 | (1.1–3.9) | 4 | 8 | (5–12) |
| | | *P (trend)* | *0.43* | *0.51* | | *0.57* | *0.35* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 75.

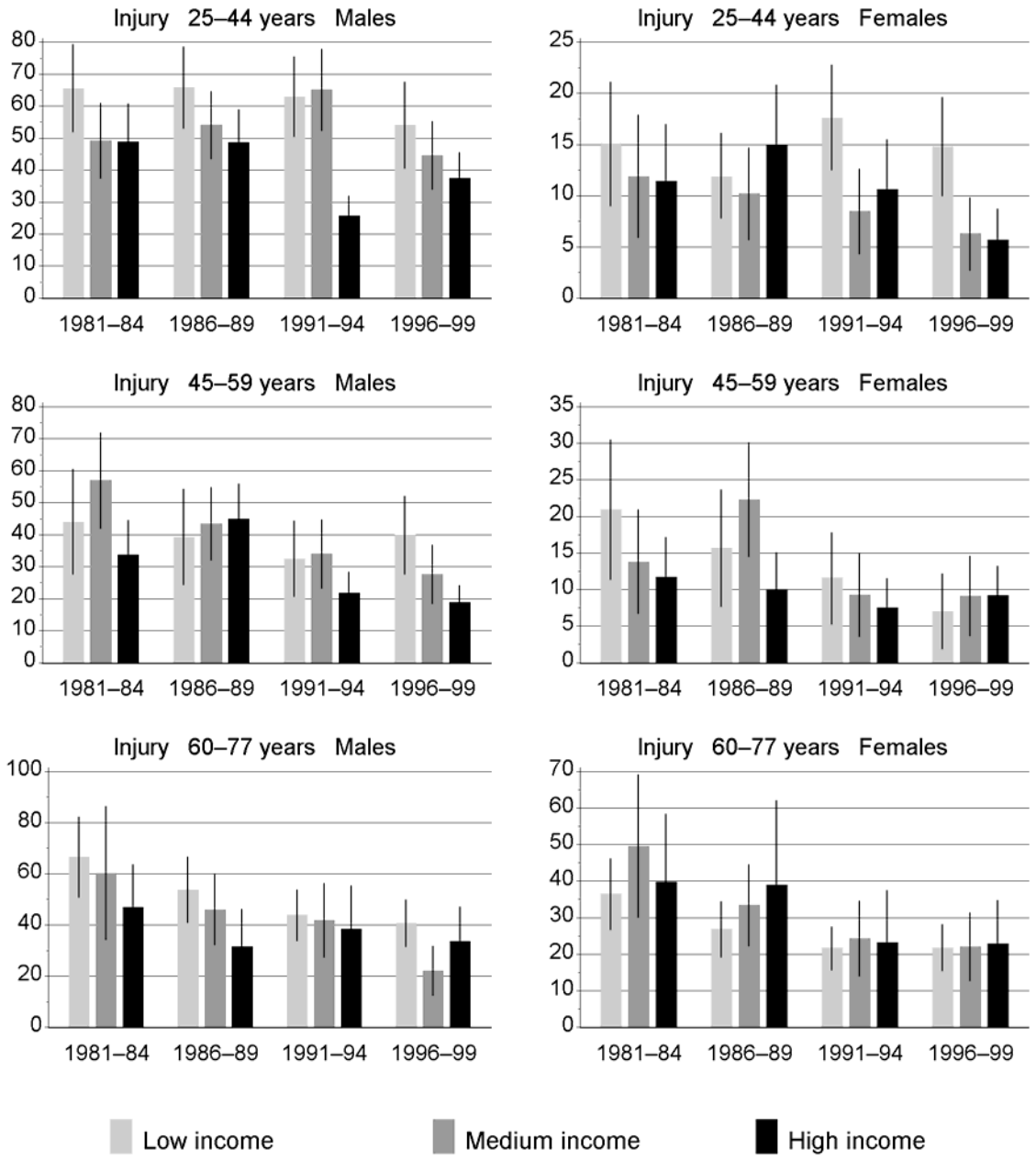
For males, the SRR (low- compared to high-income group) ranged from 1.28 to 1.88, and the 95% confidence interval always excluded the null of 1.0 (Appendix, Table 75). The RII ranged from 1.5 to 2.8 for males. However, there was no apparent trend over time in relative inequalities among males. (Strictly speaking, in the presence of background falling unintentional injury rates, at least one of either the absolute or relative inequalities must change over time. However, the estimates presented here were too imprecise to state which was changing.)

Among females, the SRR was 1.39 (95% CI 0.95 to 2.04) in 1996–99 and the RII was 2.1 (95% CI 1.1 to 3.9). The SRRs and RIIs in earlier cohorts were all less than in 1996–99, but there was no clear trend over time.

## 9.2 Age-specific rates

There were variations in the association of income with unintentional injury by age. Among females there was no robust association of income with injury mortality for the 60–77 years age group at any point in time, and among the 25–44 and 45–59 years age groups the association was unstable and statistically imprecise (Appendix, Table 75). Among males, the association was strongest and most consistent in both relative and absolute terms at younger ages, but also tended to persist into older age. The association among younger males was largely due to road traffic crash injuries (see section 9.3).

**Figure 28:** Unintentional injury mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 74.

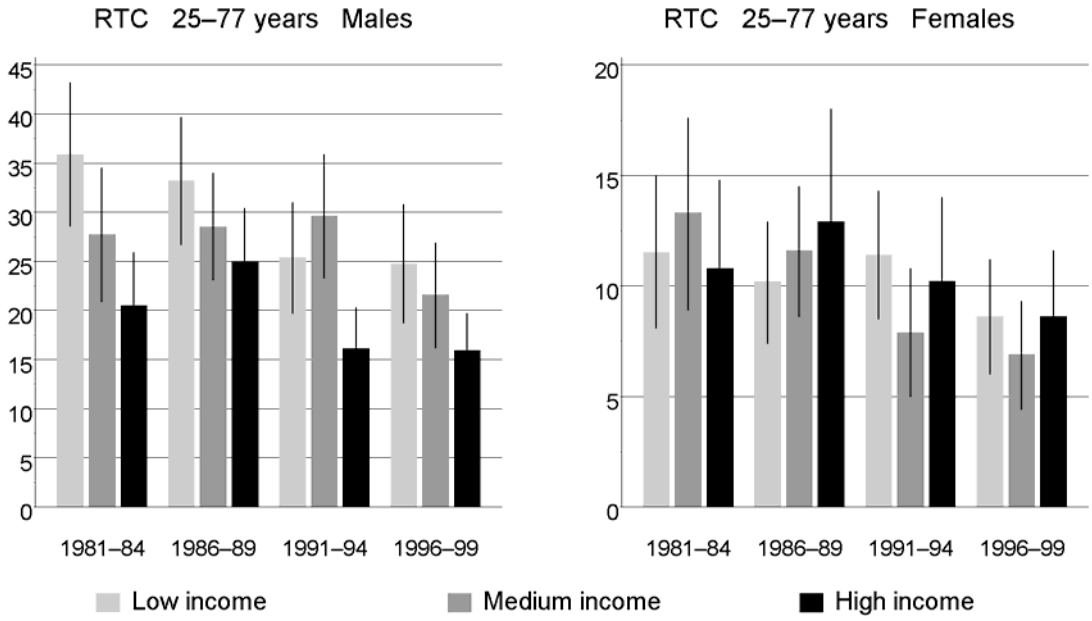
## 9.3 Road traffic crash injury

### 9.3.1 Age standardised rates (25–77 years)

Approximately half of all unintentional injury mortality was caused by road traffic crashes (RTIs), so the income gradients (and trends in these gradients) are broadly similar to those described in section 9.2. Road traffic mortality rates fell gradually during the 1980s and 1990s for males and females, for all age groups and all income groups. Across all four cohorts, lower

income was strongly associated with higher rates of male RTC mortality but not female RTC mortality.

**Figure 29:** Road traffic crash mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 76.

**Table 32:** Road traffic crash relative and absolute measures of inequality, by income, 25–77-year-olds combined

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.75 | 2.9 | (1.5–5.6) | 15 | 27 | (19–34) |
| | | 1986–89 | 1.33 | 1.7 | (1.1–2.6) | 8 | 15 | (7–22) |
| | | 1991–94 | 1.57 | 2.5 | (1.4–4.5) | 9 | 20 | (4–36) |
| | | 1996–99 | 1.55 | 2.0 | (1.1–3.5) | 9 | 13 | (8–19) |
| | | *P (trend)* | *0.79* | *0.80* | | *0.30* | *0.14* | |
| Females | 25–77 years | 1981–84 | 1.07 | 1.1 | (0.6–2.2) | 1 | 1 | (-4–6) |
| | | 1986–89 | 0.79 | 0.8 | (0.4–1.5) | -3 | -3 | (-12–5) |
| | | 1991–94 | 1.12 | 1.1 | (0.6–2.3) | 1 | 1 | (-5–7) |
| | | 1996–99 | 1.00 | 1.2 | (0.6–2.5) | 0 | 2 | (-3–7) |
| | | *P (trend)* | *0.89* | *0.57* | | *0.89* | *0.59* | |

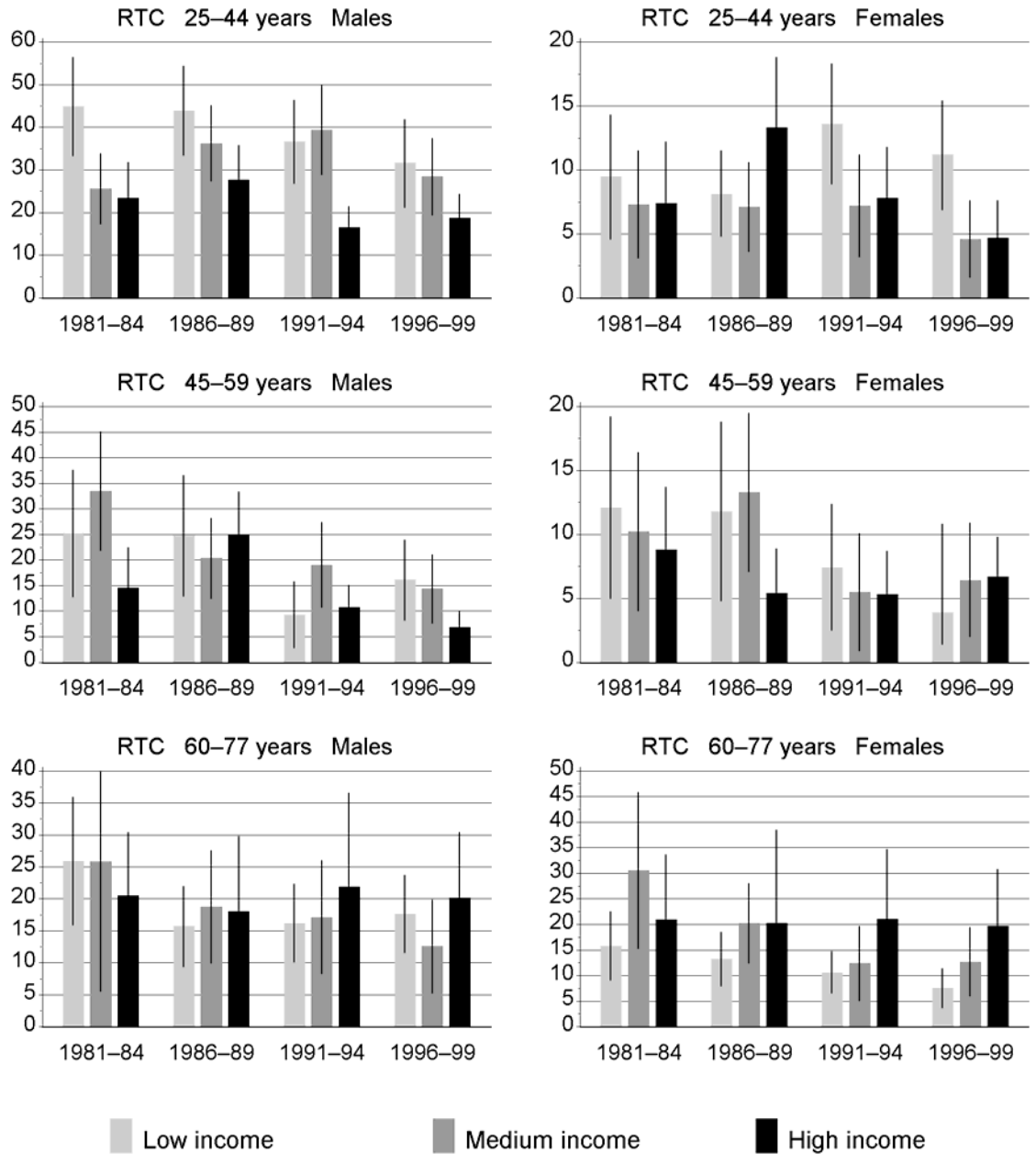
Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 77.

Absolute inequality declined over time among males (both SRD and SII), but not monotonically. There were no particular trends in relative inequality (SRR or RII) for either sex.

### 9.3.2 Age specific rates

The association of low income with higher RTC mortality was most evident among males aged 25–44 years. However, among other age groups (both sexes) there was no convincing evidence of an association of income with RTC mortality. That is, the confidence intervals of the SRR and the SRD estimates tended to include the null, and the pattern was inconsistent (Appendix, Table 77). Indeed, among 60–77-year-old females the results were more consistent with *higher* mortality among the higher income group – although 95% confidence intervals for the SRR estimates still included the null.

**Figure 30:** Road traffic crash mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 76.

Rates, SRDs and SRRs for non-road traffic crash injury deaths are shown in the Appendix, Tables 78 and 79.

# Chapter 10: Suicide

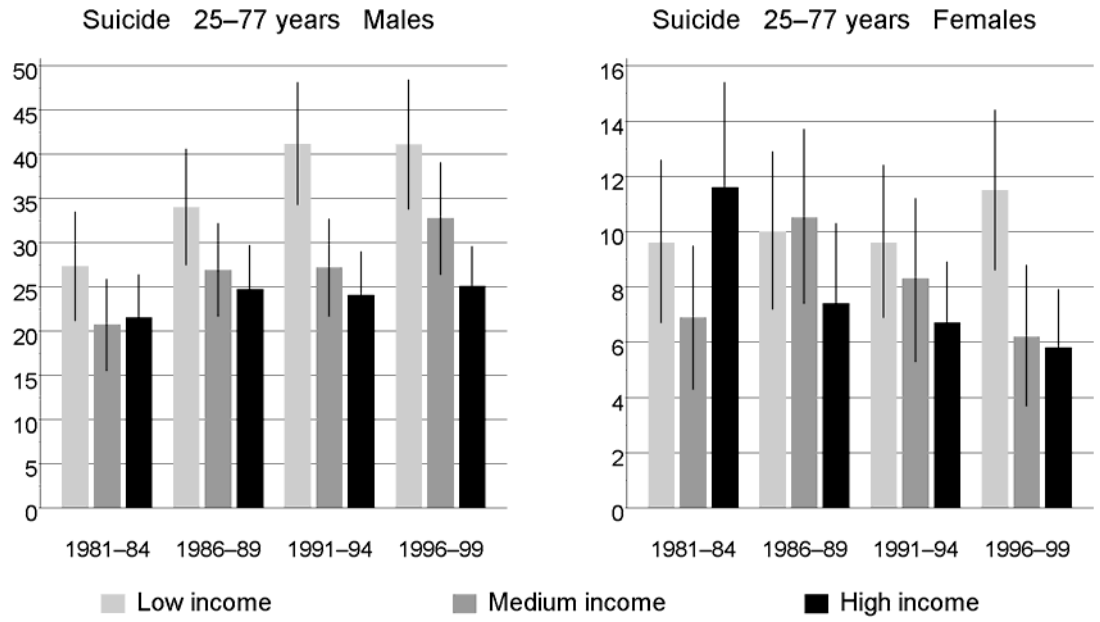
For guidance on the inequality measures used, see 'Guide to understanding trends in SRDs, SRRs, SIIs, and RIIs' (page 23).

## 10.1 Age-standardised rates (25–77 years)

Trends in suicide rates by income varied markedly by sex. For males suicide rates increased in all income groups, but more so among low-income males. In contrast, among females mortality rates decreased in high-income groups but increased in low-income groups.

Despite these varying trends by sex, both males and females experienced large increases in both relative and absolute inequality. The SRR increased from 1.27 to 1.64 among males and from 0.83 to 1.97 among females. At the same time the RII increased even more: from 1.6 to 2.4 among males and from 0.7 to 3.1 among females.

**Figure 31:** Suicide mortality rates, ages 25–77 years, by income and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 80.

**Table 33:** Suicide relative and absolute measures of inequality, by income, 25–77-year-olds combined

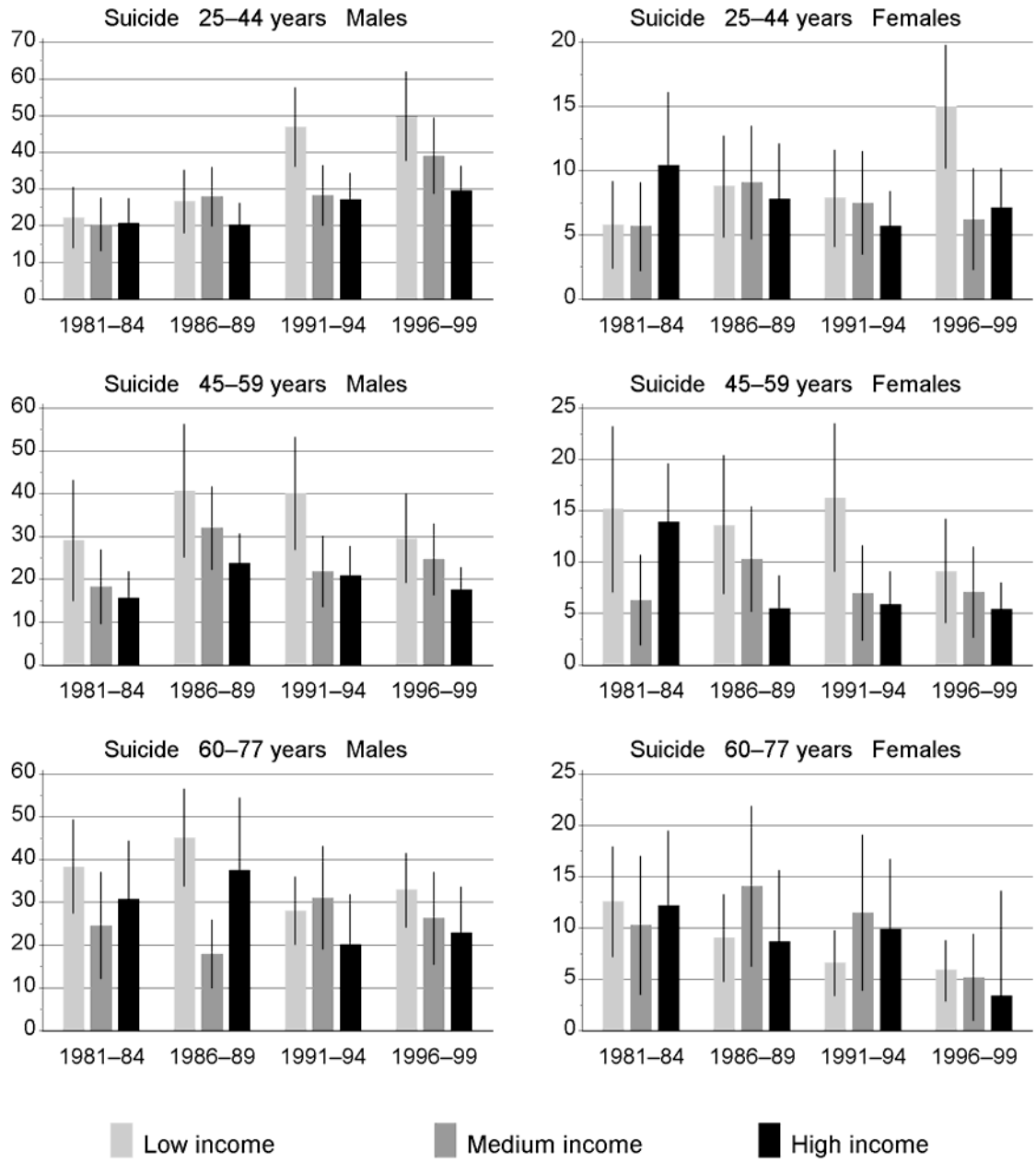
| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–77 years | 1981–84 | 1.27 | 1.6 | (1.0–2.7) | 6 | 11 | (-3–25) |
| | | 1986–89 | 1.38 | 1.9 | (1.2–3.1) | 9 | 18 | (3–33) |
| | | 1991–94 | 1.71 | 2.2 | (1.4–3.6) | 17 | 23 | (14–32) |
| | | 1996–99 | 1.64 | 2.4 | (1.5–3.8) | 16 | 26 | (10–42) |
| | | *P (trend)* | *0.13* | *0.02* | | *0.08* | *0.02* | |
| Females | 25–77 years | 1981–84 | 0.83 | 0.7 | (0.4–1.4) | -2 | -3 | (-9–3) |
| | | 1986–89 | 1.35 | 1.4 | (0.7–2.7) | 3 | 3 | (-4–9) |
| | | 1991–94 | 1.44 | 2.1 | (1.0–4.5) | 3 | 6 | (1–11) |
| | | 1996–99 | 1.97 | 3.1 | (1.2–8.0) | 6 | 8 | (-1–17) |
| | | *P (trend)* | *0.03* | *< .01* | | *0.06* | *0.03* | |

Note: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 81.

## 10.2 Age-specific rates

As has been well documented elsewhere (Beautrais 2003; Ferguson et al 2003), suicide rates among young adults increased dramatically during the 1980s and 1990s in New Zealand, particularly among young males. In parallel, suicide rates among people over 45 years have tended to fall over the same time period. Therefore any interpretation of suicide trends needs to consider the effect of age. (Youth suicide (15–24 years) is outside the age range included in this study, but will be reported elsewhere.)

**Figure 32:** Suicide mortality rates, by income, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 80.

### 10.2.1 Males, 25–44 years

In 1981–84 there was no association between income level and suicide mortality among 25–44-year-old males. However, a strong association emerges over subsequent periods as low-income males experience much greater increases in mortality than high-income males. As a result, both absolute and relative differences in suicide mortality by income increased (Table 34). The SRD increased from 2 to 20 per 100,000 and the SII from 1 to 28 per 100,000. The SRR increased from 1.08 to 1.68, and the RII increased from 1.1 to 2.1.

### 10.2.2 Males, 45–59 years

In contrast to younger males, there was a pattern for suicide mortality to be higher at lower levels of income among 45–59-year-olds in all four periods. Suicide rates increased by a similar proportion for all income levels in the middle two cohorts, but declined again in 1996–99 to levels similar to the first cohort. As a consequence, relative inequality remains relatively stable, but high, while absolute inequality peaks in the middle cohorts.

### 10.2.3 Males, 60–77 years

Allowing for statistical imprecision in the mortality rates, there was a tendency for small *decreases* in suicide mortality over time and a pattern of moderately elevated rates with lower income.

**Table 34:** Suicide relative and absolute measures of inequality, by income and age

| Sex | Age | Cohort | Relative measures of inequality | | | Absolute measures of inequality | | |
|---|---|---|---|---|---|---|---|---|
| | | | SRR low:high | RII (95% CI) | | SRD low:high | SII (95% CI) | |
| Males | 25–44 years | 1981–84 | 1.08 | 1.1 | (0.5–2.2) | 2 | 1 | (-7–10) |
| | | 1986–89 | 1.31 | 1.9 | (1.0–3.8) | 6 | 15 | (0–31) |
| | | 1991–94 | 1.72 | 2.3 | (1.2–4.4) | 20 | 26 | (3–49) |
| | | 1996–99 | 1.68 | 2.1 | (1.2–3.9) | 20 | 28 | (7–49) |
| | | *P (trend)* | *0.10* | *0.18* | | *0.05* | *0.02* | |
| | 45–59 years | 1981–84 | 1.85 | 2.8 | (0.8–9.2) | 13 | 17 | (0–35) |
| | | 1986–89 | 1.71 | 1.8 | (0.9–3.8) | 17 | 18 | (-3–39) |
| | | 1991–94 | 1.92 | 3.4 | (1.2–9.4) | 19 | 27 | (15–39) |
| | | 1996–99 | 1.68 | 2.5 | (1.1–5.9) | 12 | 19 | (6–32) |
| | | *P (trend)* | *0.70* | *0.68* | | *0.76* | *0.71* | |
| | 60–77 years | 1981–84 | 1.25 | 1.2 | (0.6–2.7) | 8 | 7 | (-35–48) |
| | | 1986–89 | 1.20 | 2.4 | (1.0–5.5) | 8 | 28 | (-5–60) |
| | | 1991–94 | 1.39 | 1.3 | (0.6–2.7) | 8 | 6 | (-2–14) |
| | | 1996–99 | 1.44 | 1.8 | (0.8–4.0) | 10 | 17 | (-14–48) |
| | | *P (trend)* | *0.14* | *0.73* | | *0.18* | *0.82* | |
| Females | 25–44 years | 1981–84 | 0.56 | 0.4 | (0.1–1.9) | -5 | -6 | (-13–1) |
| | | 1986–89 | 1.13 | 1.0 | (0.3–2.7) | 1 | 0 | (-3–3) |
| | | 1991–94 | 1.37 | 1.3 | (0.5–3.6) | 2 | 2 | (-6–9) |
| | | 1996–99 | 2.10 | 2.7 | (0.9–8.5) | 8 | 9 | (-6–24) |
| | | *P (trend)* | *0.02* | *0.02* | | *0.04* | *0.05* | |
| | 45–59 years | 1981–84 | 1.09 | 0.8 | (0.3–2.3) | 1 | -3 | (-18–13) |
| | | 1986–89 | 2.48 | 5.7 | (0.6–55.6) | 8 | 12 | (5–20) |
| | | 1991–94 | 2.78 | 8.4 | (0.4–197.9) | 11 | 15 | (6–23) |
| | | 1996–99 | 1.71 | 5.7 | (0.5–63.8) | 4 | 9 | (6–13) |
| | | *P (trend)* | *0.57* | *0.13* | | *0.96* | *1.00* | |

Notes: Standardised rate ratios (SRRs) and standardised rate differences (SRDs) comparing medium- to high-income groups, and 95% confidence intervals for all SRRs and SRDs, are presented in the Appendix, Table 81. Data for 60–77-year-old females were too sparse to present.

### 10.2.4 Females, 25–44 years

Suicide rates were lower than for males aged 25–44 years, and therefore measured with less statistical precision as reflected by the wide error bars (ie, 95% confidence intervals) in Figure 32. In 1981–84 the suicide rate of the high-income group was approximately double that of both the medium- and low-income groups. Over the next three periods the suicide rates of high-income females fell while the suicide rates of low-income females increased. Consequently, the SRR increased monotonically from 0.6 to 2.1 (p for trend = 0.02) and the SRD increased from -5 to 8 per 100,000 (p for trend = 0.05; Table 34). That is, the association of income with suicide appeared to reverse over the 1980s and 1990s.

### 10.2.5 Females, 45–59 years

Except in 1981–84, the low-income group had higher suicide mortality rates than the other income groups (Table 34). There was a tendency for suicide rates to fall in all income groups. However, trends over the 1980s and 1990s were not statistically significant for either absolute or relative measures of inequality (although the trend in RII approached significance, as conventionally defined).

### 10.2.6 Females, 60–77 years

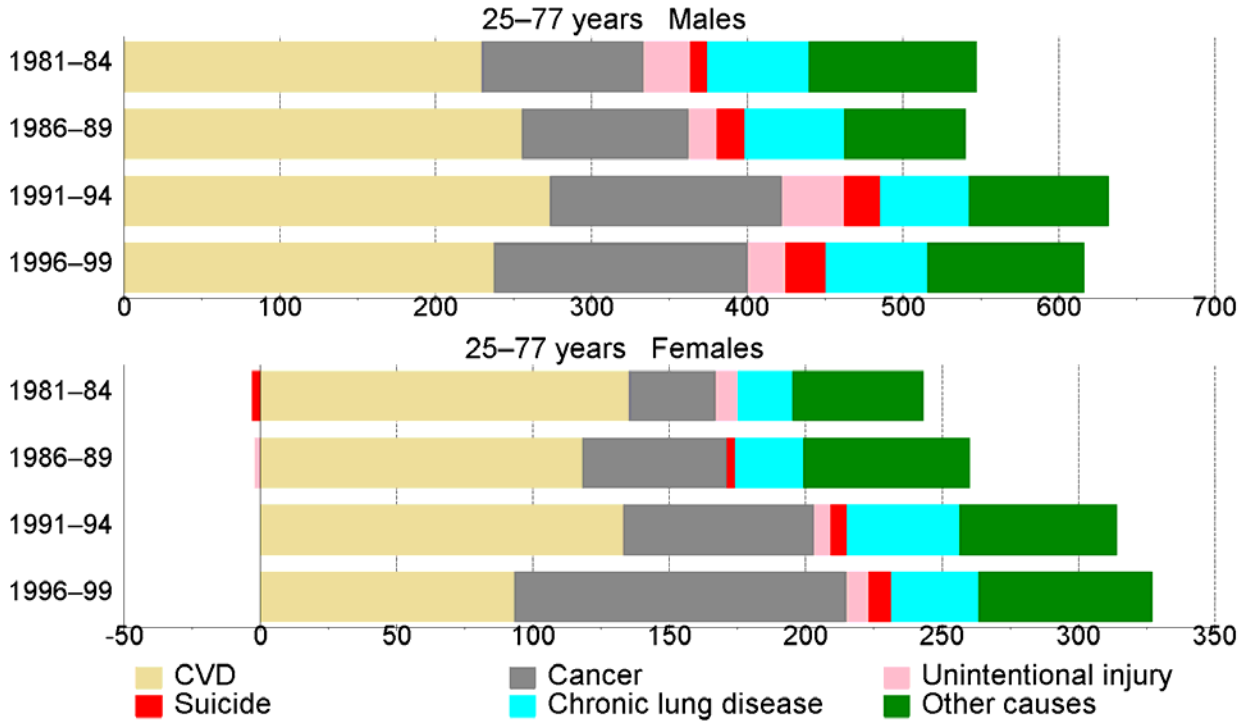
Suicide deaths among this group were uncommon, rendering all rates and measures of association too imprecise to interpret.

# Chapter 11: Contribution of Specific Causes of Death to Overall Inequality

## 11.1 Mortality rates: the slope index of inequality

Because the slope index of inequality estimates the *absolute* difference in expected mortality rates between the highest and lowest ranking people by income, it is relatively straightforward to decompose the SII for all-cause mortality into the contributions from each of the major causes of death. Decompositions are shown first for 25–77-year-olds combined (Figure 33), and then separately for each age group (Figure 34). The percentage contributions of each cause of death are summarised in Table 35. Note that the mortality rates and SIIs on which these estimates are based are all age- and ethnicity-adjusted.

**Figure 33:** Contribution of causes of death to the income SII, ages 25–77 years, by sex




A number of key points emerge from Figure 33. First, CVD mortality (in particular IHD mortality) is a major contributor to the income gradient for both genders at all times (Table 35). Not surprisingly, the contribution of CVD to the gradient was greatest for middle- and old-age groups. Among males, CVD was a reasonably stable contributor in absolute terms. However, among females the contribution of CVD to the gradient declined over the 1980s and 1990s, mostly due to declines among older women (60–77 years) (Table 35 and Figure 34).

The contribution of cancer tended to increase over time, more so for females than for males. Among females, by 1996–99 cancer contributed more to the overall income gradient in mortality than CVD. The increasing importance of cancer was not just due to lung cancer. Among females the contribution of both lung and non-lung cancers increased over time. Among males it was only the non-lung cancer contribution that increased over time (Figure 33).

**Table 35:** Percentage contributions of each cause of death to the all-cause SII for income

| Sex | Age group | Cause of death | 1981–84 | 1986–89 | 1991–94 | 1996–99 |
|---|---|---|---|---|---|---|
| Males | 25–77 years | CVD: | 42 | 47 | 43 | 38 |
| | | IHD | 23 | 34 | 30 | 26 |
| | | Stroke | 10 | 6 | 6 | 6 |
| | | Other CVD | 9 | 8 | 7 | 6 |
| | | Cancer: | 19 | 20 | 24 | 26 |
| | | Lung cancer | 9 | 15 | 9 | 12 |
| | | Non-lung cancer | 10 | 5 | 14 | 15 |
| | | Unintentional injury | 5 | 3 | 6 | 4 |
| | | Suicide | 2 | 3 | 4 | 4 |
| | | Chronic lung disease | 12 | 12 | 9 | 11 |
| | | Other causes | 20 | 14 | 14 | 16 |
| | 25–44 years | CVD | 19 | 22 | 16 | 16 |
| | | Cancer | 19 | 11 | 7 | 13 |
| | | Unintentional injury | 41 | 30 | 42 | 21 |
| | | Suicide | 1 | 20 | 17 | 21 |
| | | Chronic lung disease | 5 | 4 | 1 | 1 |
| | | Other causes | 15 | 13 | 17 | 28 |
| | 45–59 years | CVD | 37 | 37 | 44 | 41 |
| | | Cancer | 21 | 29 | 23 | 21 |
| | | Unintentional injury | 7 | 1 | 3 | 5 |
| | | Suicide | 4 | 4 | 5 | 4 |
| | | Chronic lung disease | 9 | 7 | 5 | 6 |
| | | Other causes | 23 | 22 | 21 | 23 |
| | 60–77 years | CVD | 46 | 51 | 50 | 42 |
| | | Cancer | 19 | 22 | 24 | 30 |
| | | Unintentional injury | 1 | 1 | 1 | 1 |
| | | Suicide | 0 | 1 | 0 | 1 |
| | | Chronic lung disease | 15 | 14 | 12 | 15 |
| | | Other causes | 18 | 10 | 13 | 11 |

| Sex | Age group | Cause of death | 1981–84 | 1986–89 | 1991–94 | 1996–99 |
|---|---|---|---|---|---|---|
| Females | 25–77 years | CVD: | 56 | 45 | 42 | 28 |
| | | IHD | 40 | 30 | 27 | 19 |
| | | Stroke | -2 | 9 | 5 | 3 |
| | | Other CVD | 16 | 7 | 10 | 6 |
| | | Cancer: | 13 | 20 | 22 | 37 |
| | | Lung cancer | 1 | 7 | 9 | 12 |
| | | Non-lung cancer | 12 | 13 | 14 | 25 |
| | | Unintentional injury | 3 | -1 | 2 | 2 |
| | | Suicide | -1 | 1 | 2 | 2 |
| | | Chronic lung disease | 8 | 10 | 13 | 10 |
| | | Other causes | 20 | 23 | 18 | 20 |
| | 25–44 years | CVD | – | 27 | 16 | 5 |
| | | Cancer | – | 47 | 12 | 36 |
| | | Unintentional injury | – | -3 | 22 | 22 |
| | | Suicide | – | 0 | 4 | 15 |
| | | Chronic lung disease | – | 17 | 6 | 0 |
| | | Other causes | – | 10 | 40 | 22 |
| | 45–59 years | CVD | 29 | 36 | 38 | 30 |
| | | Cancer | 29 | 25 | 23 | 36 |
| | | Unintentional injury | 4 | 4 | 2 | 0 |
| | | Suicide | -1 | 3 | 4 | 3 |
| | | Chronic lung disease | 11 | 12 | 10 | 7 |
| | | Other causes | 27 | 19 | 23 | 24 |
| | 60–77 years | CVD | 68 | 63 | 43 | 32 |
| | | Cancer | 6 | 12 | 29 | 41 |
| | | Unintentional injury | 0 | -2 | -1 | 0 |
| | | Suicide | 0 | 0 | 0 | 0 |
| | | Chronic lung disease | 7 | 6 | 18 | 13 |
| | | Other causes | 19 | 20 | 10 | 14 |

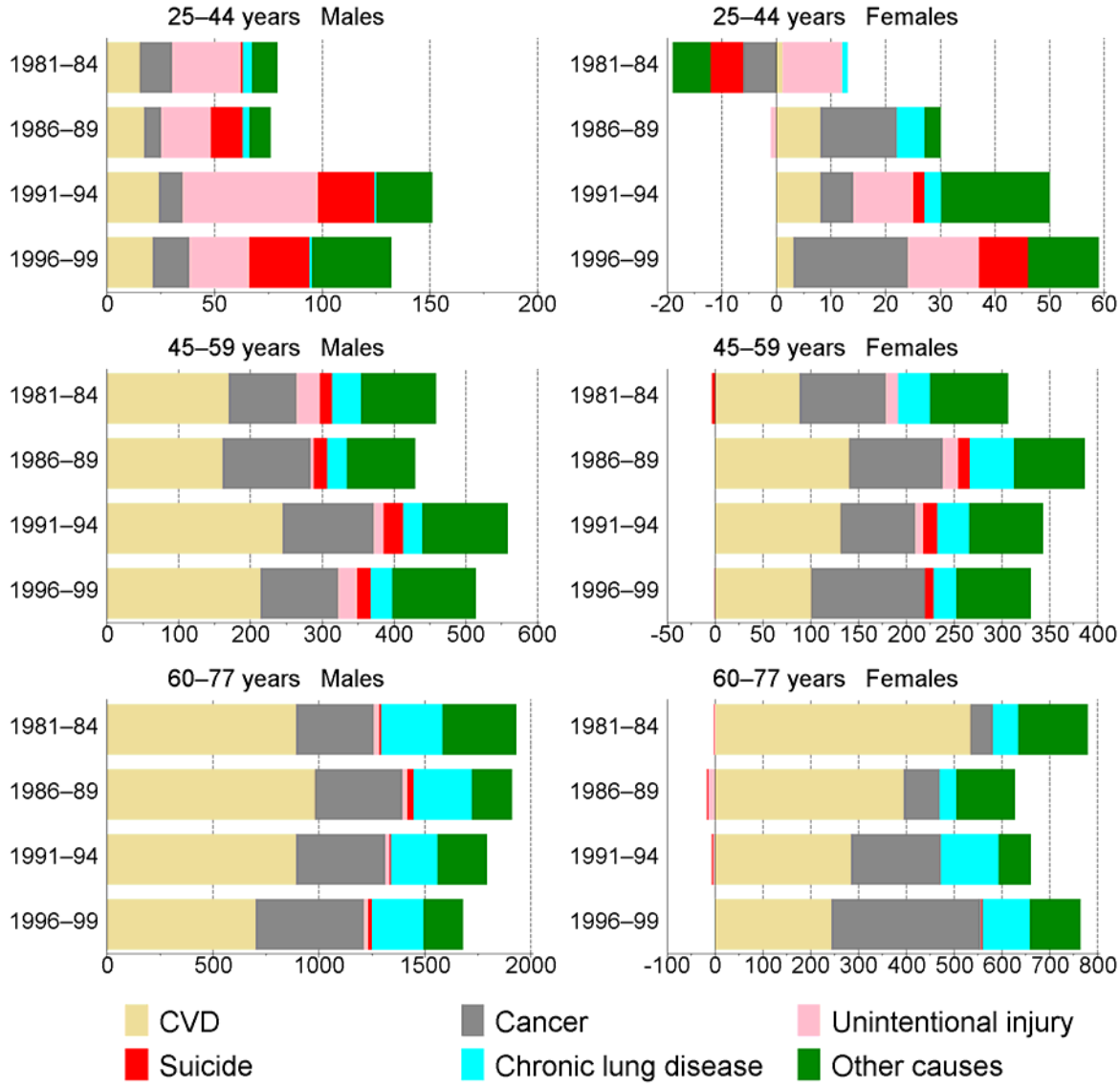
Note: Estimates for 25–44-year-old females in 1981–84 were too unstable to report.

Injury was an important contributor among young males, but not for any other age–sex group or for the overall gradient. Suicide also did not contribute prominently overall, yet among younger males (25–44 years) its contribution increased dramatically over the observation period such that by 1996–99 it made up 21% of the gradient for this age–sex group.

Chronic lung disease was also a notable contributor for all four cohorts, with an increase over time among females. The percentage contribution of chronic lung disease was greatest among older people (60–77 years).

Finally, 'other' causes of death were also significant for all cohorts. However, no single cause of death stood out within this cause category (results not presented).

**Figure 34:** Contribution of major causes of death to the income SII, by sex and age




## 11.2 Life expectancy: cause-deleted local life expectancies

Cause-deleted life expectancies enable us to estimate the contribution of different causes of death to the gaps and trends in life expectancy by income group (at birth or any part of the life-cycle). Here we examine *local* (ie, partial) life expectancy between exact ages 1 and 75 years, rather than full life expectancy, as the data for infant mortality and age groups over 77 years are modelled rather than measured directly by the NZCMS, and so are not suitable for cause deletion analysis.

We examined causes in three large groups, each disaggregated into two or three subgroups:

- CVD (IHD, stroke and other CVD)
- cancer (lung and other)
- injury (road traffic crash and other).

For both males and females, and at all time periods, these three cause groups accounted for close to half of the total gap in local life expectancy between high- and low-income groups (Table 36). The contribution of CVD has decreased, from 32% to 27% among males and, more substantially, from 38% to 25% among females, mainly reflecting a fall in the 'share' of ischaemic heart disease.

At the same time, the relative contribution of cancer has increased over time, from 9% to 16% among males and from 10% to 24% among females. So, for females, CVD and cancer now contribute equally to the income gradient in local life expectancy. The increasing cancer 'share' is completely explained by non-lung cancer among males, but reflects both lung and non-lung cancer (about equally) among females.

Injury has varied from period to period, with no clear pattern, but in all periods makes a much smaller contribution (less than 10%) to the income gradient than does chronic disease.

In summary, the trends over time in cause-deleted life expectancy are broadly similar to those for the SII trends reported above. Differences between the two reflect different outcome indicators (mortality versus survival) and measures of inequality (the SII reflecting the whole income gradient and the local life expectancy only differences between the low- and high-income groups).

**Table 36:** Cause-deleted local (1–75 years) life expectancy, gaps between high- and low-income cause-deleted local life expectancy, and change (absolute and percentage) in gap

| | Income category | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1981–84 | 1986–89 | 1991–95 | 1996–99 | 1981–84 | 1986–89 | 1991–95 | 1996–99 |
| Non-cause-deleted local LE | High | 68.0 | 68.5 | 69.5 | 70.0 | 70.5 | 70.9 | 71.3 | 71.6 |
| | Low | 65.5 | 66.1 | 66.4 | 66.9 | 69.1 | 69.3 | 69.6 | 69.9 |
| | Gap | 2.5 | 2.4 | 3.1 | 3.2 | 1.4 | 1.6 | 1.7 | 1.8 |
| CVD-deleted local LE | High | 70.1 | 70.1 | 70.8 | 71.0 | 71.4 | 71.6 | 71.8 | 72.0 |
| | Low | 68.3 | 68.5 | 68.5 | 68.7 | 70.5 | 70.5 | 70.7 | 70.7 |
| | Gap | 1.7 | 1.6 | 2.2 | 2.3 | 0.9 | 1.1 | 1.2 | 1.3 |
| | Change in LE gap | 0.8 | 0.7 | 0.9 | 0.9 | 0.5 | 0.6 | 0.5 | 0.4 |
| | % change in LE gap | 32% | 31% | 29% | 27% | 38% | 35% | 32% | 25% |
| IHD-deleted local LE | High | 69.6 | 69.7 | 70.4 | 70.7 | 71.0 | 71.3 | 71.5 | 71.8 |
| | Low | 67.3 | 67.8 | 67.9 | 68.1 | 69.8 | 70.0 | 70.1 | 70.2 |
| | Gap | 2.2 | 1.9 | 2.5 | 2.7 | 1.1 | 1.3 | 1.4 | 1.5 |
| | Change in LE gap | 0.3 | 0.4 | 0.6 | 0.5 | 0.3 | 0.3 | 0.3 | 0.2 |
| | % change in LE gap | 12% | 18% | 19% | 16% | 19% | 19% | 17% | 12% |
| Stroke-deleted local LE | High | 68.2 | 68.6 | 69.6 | 70.1 | 70.8 | 71.1 | 71.5 | 71.7 |
| | Low | 65.9 | 66.4 | 66.6 | 67.1 | 69.4 | 69.6 | 69.8 | 70.0 |
| | Gap | 2.3 | 2.3 | 3.0 | 3.0 | 1.4 | 1.5 | 1.6 | 1.6 |
| | Change in LE gap | 0.2 | 0.1 | 0.1 | 0.1 | 0.0 | 0.1 | 0.1 | 0.1 |
| | % change in LE gap | 7% | 4% | 3% | 4% | 2% | 6% | 5% | 6% |

| | Income category | Males | | | | Females | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1981–84 | 1986–89 | 1991–95 | 1996–99 | 1981–84 | 1986–89 | 1991–95 | 1996–99 |
| Cancer-deleted local LE | High | 69.4 | 69.7 | 70.7 | 71.1 | 71.9 | 72.2 | 72.6 | 72.8 |
| | Low | 67.1 | 67.7 | 68.0 | 68.5 | 70.7 | 70.8 | 71.2 | 71.5 |
| | Gap | 2.3 | 2.0 | 2.7 | 2.7 | 1.3 | 1.4 | 1.5 | 1.3 |
| | Change in LE gap | 0.2 | 0.4 | 0.3 | 0.5 | 0.1 | 0.2 | 0.2 | 0.4 |
| | % change in LE gap | 9% | 15% | 11% | 16% | 10% | 15% | 14% | 24% |
| Lung cancer-deleted local LE | High | 68.3 | 68.7 | 69.7 | 70.2 | 70.6 | 71.1 | 71.4 | 71.7 |
| | Low | 66.0 | 66.5 | 66.8 | 67.2 | 69.3 | 69.5 | 69.9 | 70.1 |
| | Gap | 2.4 | 2.2 | 2.9 | 3.0 | 1.4 | 1.6 | 1.6 | 1.6 |
| | Change in LE gap | 0.1 | 0.2 | 0.2 | 0.2 | 0.0 | 0.1 | 0.1 | 0.2 |
| | % change in LE gap | 6% | 7% | 6% | 7% | 3% | 4% | 7% | 9% |
| Non-lung cancer-deleted local LE | High | 69.0 | 69.4 | 70.5 | 71.0 | 71.8 | 72.1 | 72.5 | 72.7 |
| | Low | 66.6 | 67.3 | 67.6 | 68.1 | 70.5 | 70.6 | 70.9 | 71.2 |
| | Gap | 2.5 | 2.2 | 2.9 | 2.9 | 1.3 | 1.5 | 1.6 | 1.5 |
| | Change in LE gap | 0.1 | 0.2 | 0.2 | 0.3 | 0.1 | 0.2 | 0.1 | 0.2 |
| | % change in LE gap | 3% | 7% | 5% | 9% | 7% | 10% | 7% | 14% |
| Injury-deleted local LE | High | 69.2 | 69.5 | 70.2 | 70.7 | 70.9 | 71.3 | 71.6 | 71.8 |
| | Low | 66.7 | 67.3 | 67.5 | 67.8 | 69.5 | 69.7 | 70.0 | 70.2 |
| | Gap | 2.4 | 2.2 | 2.7 | 2.9 | 1.3 | 1.6 | 1.5 | 1.6 |
| | Change in LE gap | 0.1 | 0.2 | 0.4 | 0.3 | 0.1 | 0.0 | 0.2 | 0.1 |
| | % change in LE gap | 4% | 9% | 13% | 10% | 7% | 2% | 10% | 6% |
| Road crash-deleted local LE | High | 68.7 | 69.1 | 70.0 | 70.4 | 70.8 | 71.2 | 71.5 | 71.8 |
| | Low | 66.3 | 67.0 | 67.1 | 67.5 | 69.4 | 69.6 | 69.9 | 70.1 |
| | Gap | 2.4 | 2.2 | 2.9 | 2.9 | 1.4 | 1.6 | 1.5 | 1.7 |
| | Change in LE gap | 0.1 | 0.2 | 0.2 | 0.2 | 0.0 | 0.0 | 0.1 | 0.1 |
| | % change in LE gap | 3% | 9% | 7% | 7% | 2% | 2% | 9% | 4% |

# Chapter 12: Education, Occupational Class and Mortality

This report has focused on income as the measure of socioeconomic position for two main reasons:

- by adjusting income to 1996 dollars, a high degree of comparability is achieved across the four periods of the socioeconomic 'exposure' – a requirement for valid comparisons over time
- income has a direct relevance to policy via taxation, benefits and other redistributive policies.

One problem with the income–mortality association is that of 'reverse causation', often termed 'health selection' in the context of the study of the socioeconomic determinants of health (Blakely 2002b; Black et al 1980; Blakely et al in press). Here, one's poor health prior to death causes a drop in income earning potential, creating a spurious (in part at least) association of low income with higher death rates. Such reverse causation would apply to diseases with a protracted pre-terminal phase (eg, cancer and some CVD), possibly suicide, but not unintentional injury. One way to overcome this reverse causation bias is to examine trends by education, a socioeconomic factor that is fixed early in life for most people and therefore not subject to health selection bias.

An examination of the association of education with mortality also lends itself to different interpretations from the income–mortality association. First, education represents a different facet of the wider construct of socioeconomic position. Education is a measure of human capital, and (in Weberian terms) one's access to future opportunities (Lynch and Kaplan 2000; Edgell 1993), including opportunities for good health. Second, education is a measure of knowledge that one might expect to translate into different rates of adopting and ceasing various health-related behaviours. Third, educational attainment has changed dramatically over time, with each successive birth cohort (on average) attaining higher levels of education than its predecessor. While this may be regarded as a problem when interpreting comparisons over time, it may also be a strength. For example, if increasing social exclusion is a feature of the last 20–30 years in New Zealand society, then one might expect the health effects to be manifest mainly among the diminishing number of people who attain no educational qualification.

Fourth, education captures a person's socioeconomic position at one point of the life-course – early adulthood. Accordingly, relative to other socioeconomic factors like income that vary over the life course, we might expect the association of education with disease outcomes to be stronger in early adulthood. However, such an argument is not absolute because the different meaning of 'education' for different birth cohorts (as described above) might offset any proximity of the education exposure to any particular disease.

Occupational class, a measure of the construct of social class, sits alongside education and income as one of the three 'big' socioeconomic measures to consider. There are generally two ways to view social class – Marxist or Weberian – although more functionalist perspectives have been a feature of North American tradition (Lynch and Kaplan 2000). The two most commonly used measures of occupational class in New Zealand have been the Elley Irving scale (Elley and Irving 1976) and the New Zealand Socio-Economic Index (NZSEI) (Davis et al 1999; Davis et al 2004; Davis et al 1997; Davis et al 2003). Both use a Weberian approach of ranking occupations

into socioeconomic strata on the basis of educational requirement and monetary rewards (ie, they are primarily skill-based).

Unfortunately, occupational class analyses in the NZCMS are limited for two inter-related reasons. First, the New Zealand Census only collects occupations for people *currently* employed on census night. The resultant exclusion has been shown overseas (Kunst et al 1998a; Martikainen and Valkonen 1999), and in New Zealand (Blakely 2002), to result in an *underestimation* of the association of occupational class with mortality. Accordingly, we have to adjust occupational class data for this undercount (Kunst et al 1998a, 1998b) – an additional methodological step that will introduce additional uncertainty. Second, the number of people with a current occupation (formal and paid) is substantially less than the total population. Thus all analyses of occupational class are undertaken on a much restricted data set. Nevertheless, results by occupational class may provide an extra consistency check against the income and education results.

The purpose of this chapter is to present selected results by education and occupational class. Where possible, we use these results to try to answer questions that arise from the results on income presented earlier in this report.

## 12.1 Distribution of person-time by education and occupational class

For the purpose of comparisons over time, the most parsimonious grouping of highest educational qualification is into nil, school and post-school categories (Table 37). In calculating SIIs and RIIs, however, we used a five-level classification: nil; 5th form school qualifications; 6th/7th form qualifications; trades and other post-school qualifications; university degree, nursing or teaching diploma or technician's certificate. It is clear that the proportion of the population in all age groups with nil qualifications has decreased dramatically over time – a function of successive birth cohorts attaining higher levels of education, and of the census question recognising a broader range of qualifications over time. Conversely, the proportion of people with post-school qualifications steadily increased in all age groups.

The percentage of the cohorts aged 25–44 and 45–59 with missing occupational class is shown in Table 38 below. (It is not possible to conduct analyses for 60–77-year-olds due to the majority of these people being retired, and hence having no current occupation.) The proportion of females without a current occupation declined over time from nearly half to about a third by 1996–99. Among males, however, a reverse trend emerged, with the missing data rate increasing from about 10% in the early 1980s to 22% in 1996–99. Given the high level of missing data, results for occupational class mortality gradients should be treated cautiously (especially for females).

**Table 37:** Person years in each educational category over time by age

| Sex | Age group | Highest qualification | 1981 | | 1986 | | 1991 | | 1996 | |
|---|---|---|---|---|---|---|---|---|---|---|
| Males | 25–77 years | Nil | 1,141,845 | 53% | 914,791 | 38% | 883,791 | 32% | 944,384 | 33% |
| | | School | 346,167 | 16% | 430,108 | 17% | 533,227 | 19% | 691,753 | 24% |
| | | Post-school | 644,749 | 30% | 1,061,383 | 44% | 1,263,007 | 47% | 1,221,669 | 42% |
| | | Missing | 215,528 | | 152,682 | | 57,450 | | 157,037 | |
| | 25–44 years | Nil | 469,401 | 42% | 403,501 | 31% | 382,319 | 27% | 379,966 | 26% |
| | | School | 228,230 | 20% | 256,587 | 20% | 302,919 | 21% | 395,470 | 27% |
| | | Post-school | 395,829 | 36% | 606,142 | 47% | 703,931 | 50% | 650,656 | 45% |
| | | Missing | 87,316 | | 57,726 | | 23,164 | | 79,362 | |
| | 45–59 years | Nil | 369,528 | 59% | 286,055 | 42% | 285,278 | 38% | 308,764 | 35% |
| | | School | 73,618 | 11% | 91,756 | 13% | 112,468 | 15% | 186,419 | 21% |
| | | Post-school | 173,006 | 28% | 288,549 | 43% | 351,477 | 46% | 376,881 | 43% |
| | | Missing | 64,815 | | 40,877 | | 14,919 | | 43,143 | |
| | 60–77 years | Nil | 302,916 | 71% | 225,236 | 47% | 216,194 | 39% | 255,655 | 45% |
| | | School | 44,319 | 10% | 81,765 | 17% | 117,840 | 21% | 109,865 | 19% |
| | | Post-school | 75,915 | 17% | 166,691 | 35% | 207,599 | 38% | 194,132 | 34% |
| | | Missing | 63,397 | | 54,079 | | 19,367 | | 34,532 | |
| Females | 25–77 years | Nil | 1,317,135 | 61% | 1,153,252 | 47% | 1,044,219 | 37% | 1,062,000 | 35% |
| | | School | 381,901 | 17% | 551,390 | 22% | 762,152 | 27% | 935,254 | 31% |
| | | Post-school | 442,305 | 20% | 710,321 | 29% | 969,226 | 34% | 1,012,163 | 33% |
| | | Missing | 276,219 | | 223,609 | | 69,929 | | 145,510 | |
| | 25–44 years | Nil | 529,705 | 49% | 476,106 | 37% | 417,563 | 29% | 381,309 | 25% |
| | | School | 265,147 | 24% | 341,258 | 27% | 427,514 | 29% | 555,285 | 36% |
| | | Post-school | 277,712 | 25% | 439,149 | 34% | 591,003 | 41% | 583,301 | 38% |
| | | Missing | 110,032 | | 79,677 | | 21,854 | | 68,658 | |
| | 45–59 years | Nil | 401,447 | 68% | 350,805 | 55% | 343,625 | 46% | 356,272 | 40% |
| | | School | 73,725 | 12% | 111,225 | 17% | 153,153 | 20% | 234,181 | 26% |
| | | Post-school | 109,719 | 18% | 175,259 | 27% | 249,300 | 33% | 292,769 | 33% |
| | | Missing | 76,079 | | 57,844 | | 17,707 | | 39,534 | |
| | 60–77 years | Nil | 385,984 | 79% | 326,341 | 62% | 283,031 | 47% | 324,418 | 53% |
| | | School | 43,029 | 8% | 98,907 | 18% | 181,485 | 30% | 145,788 | 24% |
| | | Post-school | 54,875 | 11% | 95,913 | 18% | 128,922 | 21% | 136,093 | 22% |
| | | Missing | 90,109 | | 86,088 | | 30,368 | | 37,318 | |

**Table 38:** Percentage of cohort population with missing or non-codable occupational class information by sex, age and cohort

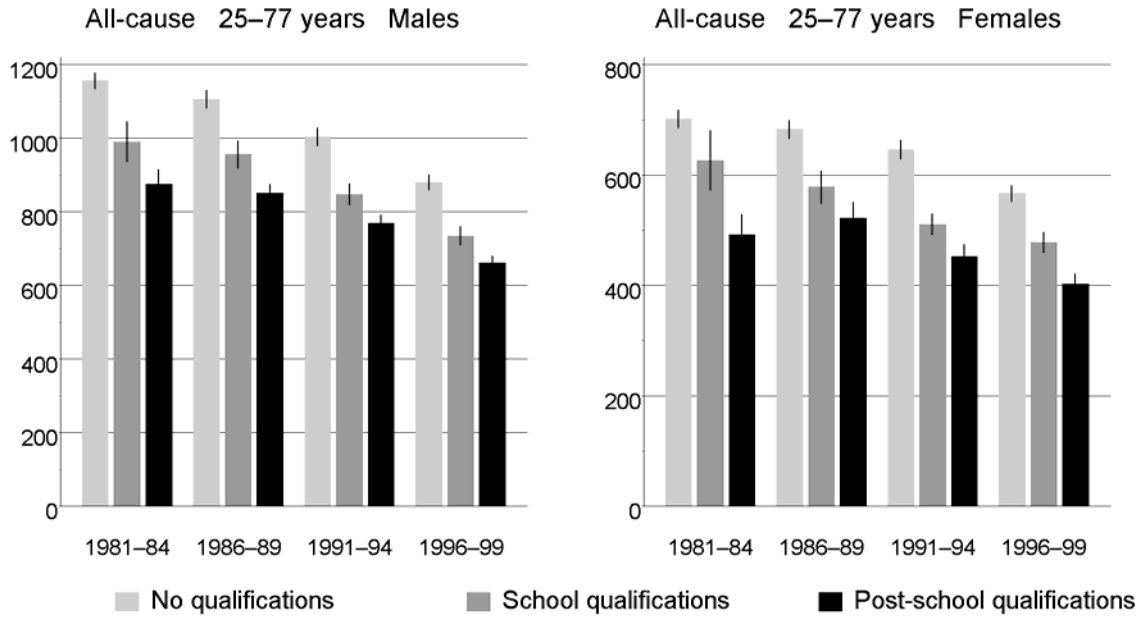
| Sex | Age | Census cohort | | | |
|---|---|---|---|---|---|
| | | 1981–84 | 1986–89 | 1991–94 | 1996–99 |
| Males | 25–44 years | 8 | 8 | 19 | 22 |
| | 45–59 years | 11 | 10 | 20 | 22 |
| | Total | 9 | 9 | 20 | 22 |
| Females | 25–44 years | 45 | 38 | 41 | 37 |
| | 45–59 years | 48 | 41 | 39 | 35 |
| | Total | 46 | 39 | 40 | 36 |

## 12.2 Was the association of mortality with education and occupational class similar to that with income?

### 12.2.1 Education

As with the income results, mortality rates within each level of education tended to fall over time, and inequalities in mortality by education were evident for each age group (Figures 35 and 36). Regarding trends over time in inequalities by education, rate ratios comparing nil to post-school highest qualifications increased among 25–44-year-old females (and also possibly 25–44-year-old males), but were otherwise generally similar over time for the older age groups (Appendix, Table 83). Given the overall trend of falling mortality rates, rate differences between people with nil and post-school highest qualifications tended to fall over time – except among 25–44-year-olds (Appendix, Table 83).

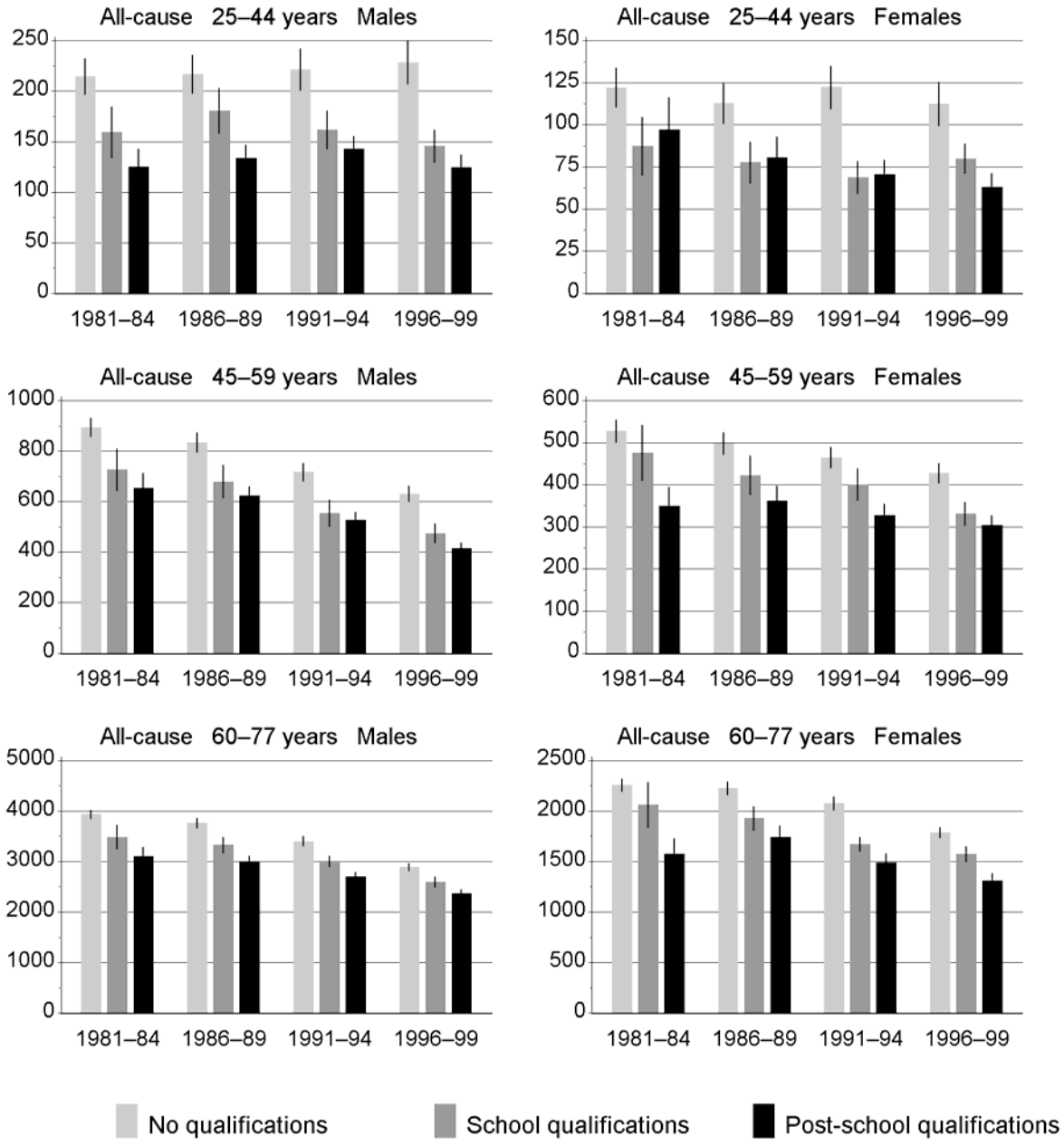
**Figure 35:** All-cause mortality rates, ages 25–77 years, by education and sex




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 82.

The educational level of the population has been steadily increasing over time, with a consequent shift in the size of the educational categories over the four cohorts. The proportion of the population with no qualifications has decreased while the proportion with both school and post-school qualifications has increased substantially. Changes over time in the size and meaning of the education groups make interpretation of the trends in the SRR and SRD problematic. However, the SII and RII overcome this problem by taking account of the distribution of the population by education level.

**Figure 36:** All-cause mortality rates, by education, sex and age




Note: Age- and ethnicity-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 82.

Table 39 below compares the RII and SII by income and education for all causes. The following main points are evident for 25–77-year-olds combined.

- Absolute inequalities in mortality (as measured by the SII) tended to decrease over time according to education but remained stable or increased slightly according to income.
- Relative inequalities in mortality (as measured by the RII) increased over time according to both education and income, but more so for income.

**Table 39:** Comparing all-cause mortality inequalities measured using education and income

| Sex | Age | Cohort | Relative index of inequality (RII) | | | Slope index of inequality (SII) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Income | Education (95% CI) | | Income | Education (95% CI) | |
| Males | 25–77 years | 1981–84 | *1.7* | 1.6 | (1.4–1.8) | *547* | 468 | (410–526) |
| | | 1986–89 | *1.8* | 1.6 | (1.5–1.7) | *540* | 461 | (351–572) |
| | | 1991–94 | *2.3* | 1.7 | (1.6–1.8) | *632* | 428 | (284–571) |
| | | 1996–99 | *2.6* | 1.7 | (1.6–1.8) | *616* | 389 | (235–543) |
| | | *P (trend)* | *0.03* | *< .01* | | *0.26* | *< .01* | |
| | 25–44 years | 1981–84 | *1.6* | 2.5 | (1.8–3.5) | *79* | 145 | (100–191) |
| | | 1986–89 | *1.6* | 2.7 | (2.1–3.5) | *76* | 154 | (89–219) |
| | | 1991–94 | *2.7* | 2.3 | (1.8–2.9) | *151* | 129 | (78–180) |
| | | 1996–99 | *2.5* | 3.0 | (2.3–4.0) | *132* | 157 | (84–229) |
| | | *P (trend)* | *0.14* | *0.68* | | *0.18* | *0.92* | |
| | 45–59 years | 1981–84 | *1.8* | 1.7 | (1.4–2.0) | *458* | 416 | (287–544) |
| | | 1986–89 | *1.9* | 1.8 | (1.5–2.0) | *429* | 391 | (268–514) |
| | | 1991–94 | *2.9* | 1.9 | (1.6–2.1) | *558* | 359 | (200–519) |
| | | 1996–99 | *3.3* | 2.3 | (2.0–2.6) | *514* | 388 | (231–546) |
| | | *P (trend)* | *0.06* | *0.08* | | *0.29* | *0.30* | |
| | 60–77 years | 1981–84 | *1.7* | 1.5 | (1.3–1.6) | *1931* | 1389 | (1044–1733) |
| | | 1986–89 | *1.8* | 1.5 | (1.4–1.6) | *1911* | 1327 | (1097–1558) |
| | | 1991–94 | *1.9* | 1.5 | (1.4–1.6) | *1791* | 1203 | (838–1569) |
| | | 1996–99 | *2.0* | 1.4 | (1.3–1.5) | *1680* | 923 | (519–1327) |
| | | *P (trend)* | *< .01* | *0.48* | | *0.03* | *0.06* | |

| Sex | Age | Cohort | Relative index of inequality (RII) | | | Slope index of inequality (SII) | | |
|---|---|---|---|---|---|---|---|---|
| | | | Income | Education (95% CI) | | Income | Education (95% CI) | |
| Females | 25–77 years | 1981–84 | *1.5* | 1.6 | (1.4–1.9) | *243* | 313 | (148–479) |
| | | 1986–89 | *1.6* | 1.6 | (1.4–1.7) | *260* | 268 | (245–291) |
| | | 1991–94 | *1.9* | 1.8 | (1.6–2.0) | *314* | 306 | (217–394) |
| | | 1996–99 | *2.2* | 1.8 | (1.6–2.0) | *327* | 271 | (223–319) |
| | | *P (trend)* | *< .01* | *0.21* | | *0.04* | *< .01* | |
| | 25–44 years | 1981–84 | *1.1* | 1.8 | (1.3–2.4) | *6* | 58 | (9–106) |
| | | 1986–89 | *1.4* | 1.8 | (1.3–2.6) | *30* | 52 | (3–101) |
| | | 1991–94 | *1.9* | 2.5 | (1.8–3.4) | *50* | 73 | (13–134) |
| | | 1996–99 | *2.2* | 2.4 | (1.7–3.3) | *59* | 66 | (38–95) |
| | | *P (trend)* | *< .01* | *0.13* | | *0.06* | *0.31* | |
| | 45–59 years | 1981–84 | *2.0* | 1.7 | (1.3–2.2) | *306* | 256 | (114–398) |
| | | 1986–89 | *2.7* | 1.7 | (1.5–2.1) | *386* | 241 | (160–322) |
| | | 1991–94 | *2.6* | 1.8 | (1.5–2.1) | *343* | 226 | (191–260) |
| | | 1996–99 | *3.0* | 1.9 | (1.6–2.2) | *330* | 215 | (135–295) |
| | | *P (trend)* | *0.10* | *0.03* | | *0.85* | *< .01* | |
| | 60–77 years | 1981–84 | *1.5* | 1.6 | (1.4–1.8) | *779* | 990 | (430–1550) |
| | | 1986–89 | *1.4* | 1.5 | (1.3–1.6) | *627* | 791 | (703–879) |
| | | 1991–94 | *1.5* | 1.7 | (1.5–1.8) | *660* | 912 | (673–1152) |
| | | 1996–99 | *1.7* | 1.6 | (1.5–1.7) | *764* | 746 | (559–933) |
| | | *P (trend)* | *0.27* | *0.62* | | *0.84* | *0.75* | |

Comparing the education and income SIIs and RIIs in Table 39 within age-groups, we note the following.

- Absolute inequalities according to the SII were stable over time in all sex-by-age groups according to education – except for a decrease over time among 60–77-year-old males and 45–59-year-old females. In contrast, the income SIIs increased among 25–44-year-olds, but decreased for 60–77-year-old males, in agreement with the education SII.
- Among 25–44-year-olds, relative inequalities by education were greater than by income. While the education RIIs increased over time, the income RIIs increased more rapidly to be close to education inequalities by 1996–99.
- Among 45–59-year-olds, income RIIs were greater than education RIIs at all points in time. Both the education and income RIIs increased over time, but more so for income.
- Among 60–77-year-old males income RIIs were greater than education RIIs, but among 60–77-year-old females the education and income RIIs were similar. The education RIIs were stable over time, but the income RIIs increased.

Trends over time in the education SRDs and SRRs (Appendix, Table 83) were broadly similar to those for the education SIIs and RIIs shown in Table 39 above.

As an overall summary of both income and educational results in this report, we conclude that:

- absolute socioeconomic inequalities in mortality among males and females aged 25–77 years were stable on average over the 1980s and 1990s, whereas relative inequalities increased
- relative inequalities in mortality among males and females aged 25–77 years increased more using income as the measure of socioeconomic position (approximately doubling) than using education
- increasing socioeconomic inequalities in all-cause mortality over time were most notable among 25–44-year-olds
- educational inequalities in mortality tended to be greater than income inequalities among 25–44-year-olds, while the opposite was found for 45–59 and 60–77-year-olds.

Possible interpretations of these differences in relative inequalities by income and education include the following.

- *Measurement accuracy:* at younger age groups (ie, 25–44-years) highest qualifications are a more meaningful measure of socioeconomic position, whereas income is more unstable among this age group, with people having not yet attained their full income earning potential. Accordingly, mortality gradients at younger ages will be stronger for education.
- *Life-course:* education is a more proximal measure of socioeconomic position during early adulthood, but a more distant and less relevant measure of socioeconomic position among older people. Accordingly, we might expect mortality differences by education to wane with increasing age.
- *Cohort effects:* there may be cohort effects whereby for younger cohorts education is a more important determinant of life chances such as employment than it was for older cohorts. Accordingly, we might expect mortality differences by education to be less in older age groups. While this possibility predicts an identical picture to the above two at any one point in time, over time (and particularly into the future) it would predict increasing educational gradients in middle and older age groups. Although there was some evidence of increasing education RIIs (but not SIIs) among 45–59-year-olds from 1981–84 to 1996–99 (males more so than females), the same was not true for 60–77-year-olds (Table 39). And the increases in relative inequalities in mortality by education were not as marked as those by income.

### 12.2.2 Occupational class

It must be emphasised again that the occupational class gradients are prone to bias, so we can only make comparisons in broad terms.

Considering occupational class, relative inequalities in 25–59-year-old all-cause mortality doubled during the 1980s and 1990s for both males and females (RIIs in Table 40). Absolute inequalities by occupational class increased by approximately a third among females, but were stable over time for males (SIIs in Table 40). These patterns are also evident on a visual inspection of the histograms in Figure 37 below. (We do not present results by age group in this report.)

**Figure 37:** All-cause mortality rates, ages 25–59 years, by occupational class and sex

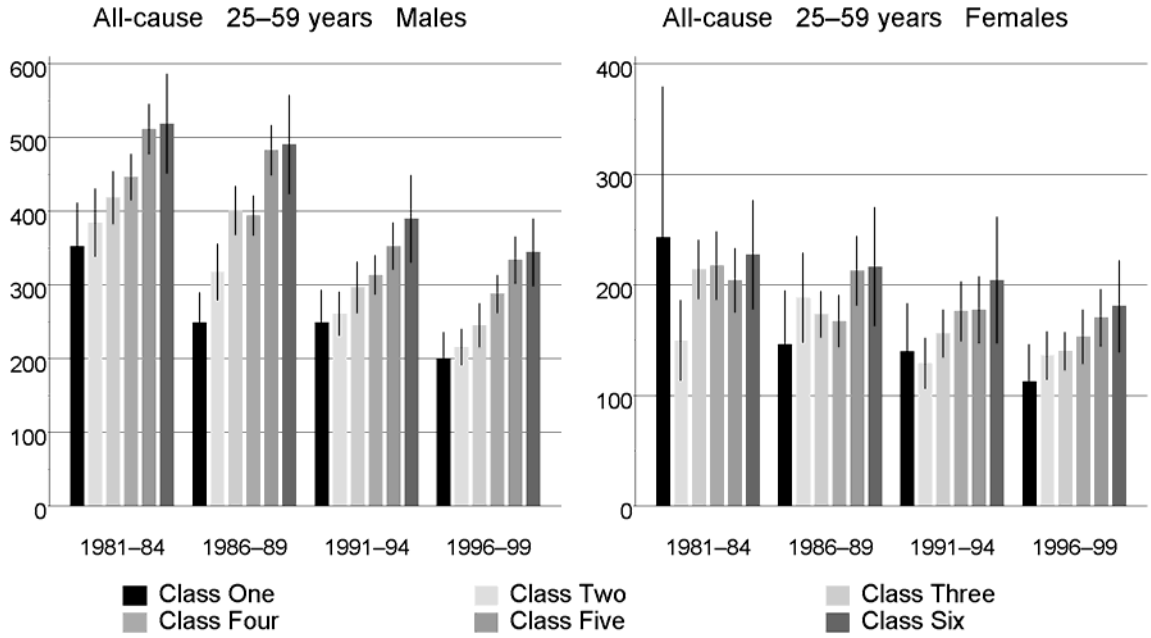



**Table 40:** All-cause mortality relative and absolute measures of inequality, by occupational class, 25–59-year-olds combined

| Sex | Period | RII (95% CI) | | P (trend) | SII (95% CI) | | P (trend) |
|---|---|---|---|---|---|---|---|
| Males | 1981–84 | 1.73 | (1.51–1.97) | – | 234 | (182–286) | – |
| | 1986–89 | 2.12 | (1.83–2.45) | – | 283 | (187–380) | – |
| | 1991–94 | 1.87 | (1.57–2.23) | – | 184 | (136–231) | – |
| | 1996–99 | 2.52 | (2.06–3.08) | 0.22 | 238 | (181–295) | 0.75 |
| Females | 1981–84 | 1.35 | (1.06–1.72) | – | 61 | (14–109) | – |
| | 1986–89 | 1.42 | (1.10–1.83) | – | 63 | (-2–128) | – |
| | 1991–94 | 1.59 | (1.20–2.09) | – | 73 | (47–99) | – |
| | 1996–99 | 1.73 | (1.34–2.24) | 0.01 | 79 | (45–113) | 0.01 |

Comparing these occupational class mortality gradients with 25–44 and 45–59-year-olds' gradients for income and education presented elsewhere in this report (eg, Table 39), the overall pattern is reasonably consistent. (It is not appropriate to compare the 25–59-year-old occupational class results with the 25–77-year-old results for income and education as the latter are unduly influenced by deaths among 60–77-year-olds.) For example, the doubling of relative inequality by occupational class for females is not inconsistent with the changes over time by income and education for 25–44 and 45–59-year-olds, and likewise for males. The stable absolute inequalities by occupational class for males, and increasing absolute inequalities for females, are also not inconsistent with income results – assuming that the increasing female inequality by class reflects the influence of the 25–44-year-old females evident for income.

## 12.3 Is the pattern of no mortality improvement among low-income 25–44-year-olds evident by education?

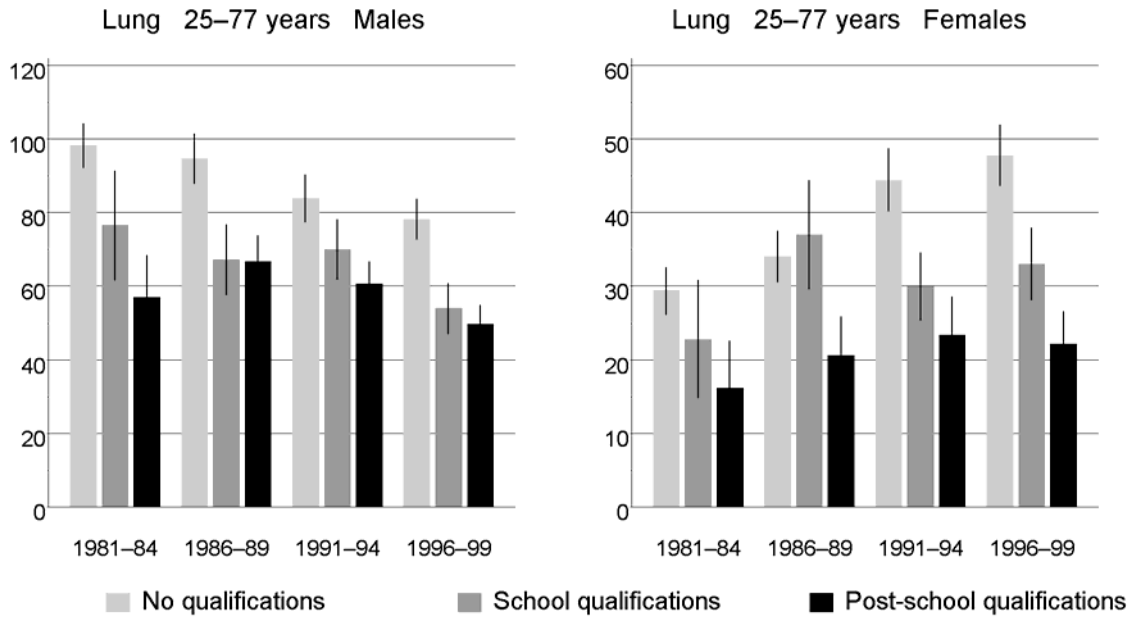
Earlier in this report we observed that among 25–44-year-olds only high-income groups showed any improvement in mortality over time. Low- and medium-income groups showed no mortality improvement in this age group. For mortality by education, among 25–44-year-old males we found no improvement in mortality rates for any educational group (Figure 36). However, among 25–44-year-old females, mortality rates did fall over time for people with post-school highest qualifications (and possibly school qualifications), whereas they remained static for 25–44-year-old females with nil qualifications.

In summary, therefore, assuming that both education and income measure the same underlying socioeconomic construct, the weight of evidence suggests that any mortality gains among 25–44-year-olds appear to have involved only the higher socioeconomic group.

## 12.4 Is the pattern of rapidly increasing inequalities in female lung cancer by income reproduced by education?

Profound widening of absolute and relative inequalities by income in female lung cancer were presented in section 8.2. Figure 38 shows that the trends in lung cancer mortality rates by education were similar to, but not as extreme as, those by income. The education RII increased from 2.5 (95% CI 1.4 to 4.5) in 1981–84 to 4.1 (95% CI 2.5 to 6.7) in 1996–99 (p for trend 0.18). The SII increased from 22 per 100,000 (95% CI 10 to 34) to 42 (95% CI 34 to 49) (p for trend 0.03).

**Figure 38:** Lung cancer mortality rates, ages 25–77 years, by education and sex



## 12.5 Is the non-linear trend, or 'peaking', of absolute inequalities in CVD by income reproduced by education?

Based on theoretical expectations outlined in section 1.7, we looked closely for non-linear trends in the absolute inequalities in CVD mortality in Chapter 6. In that chapter, we found suggestive evidence that absolute inequalities in CVD by income for males aged 60–77 increased to a peak in 1986–89, then decreased. Table 41 shows that the trends by education were not dissimilar to those by income.

**Table 41:** Cardiovascular disease absolute measures of inequality, by income and education, 65–77-year-old males only

| Cohort | Income | | | Education | | |
|---|---|---|---|---|---|---|
| | SRD low:high | SII (95% CI) | | SRD low:high | SII (95% CI) | |
| 1981–84 | 622 | 889 | (737–1042) | 309 | 499 | (130–868) |
| 1986–89 | 694 | 980 | (706–1254) | 411 | 697 | (553–841) |
| 1991–94 | 580 | 891 | (789–994) | 301 | 500 | (357–643) |
| 1996–99 | 453 | 699 | (549–848) | 186 | 338 | (133–544) |
| *P (trend)* | *0.17* | *0.34* | | *0.15* | *0.18* | |

## 12.6 Contribution of causes of death to the total education SII

It is possible that the interpretation of the contributions of various causes of death to the overall gap using the income SIIs in Chapter 11 might be biased due to reverse causation effects that vary by cause of death or over time. Figure 39 shows a similar analysis using the education SIIs. While using education overcomes biases due to reverse causation, cohort effects and the changing meaning of 'education' over time introduce a different set of concerns about interpreting time trends. Nevertheless, some commonality of patterns between the income and education SIIs would be reassuring for the overall interpretation of what is driving the contribution to *socioeconomic* gaps more generally.

**Figure 39:** Contribution of causes of death to the education SII, ages 25–77 years, by sex

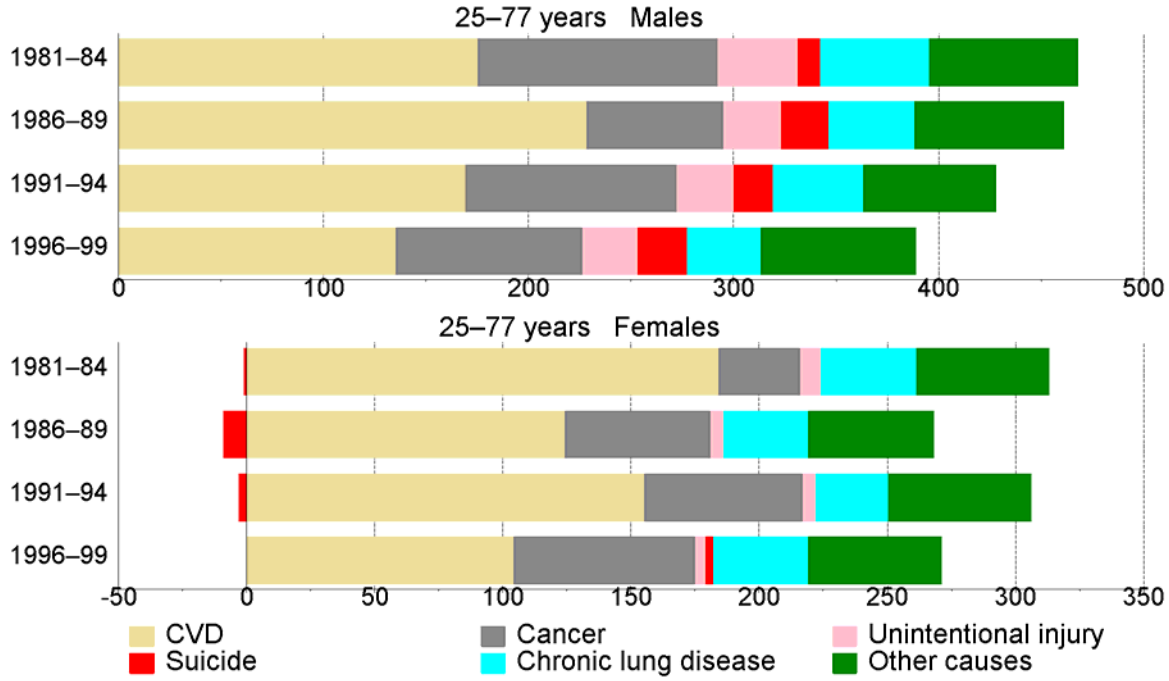



**Table 42:** Percentage contributions of each cause of death to the all-cause SII, by education

| Sex | Age group | Cause of death | 1981–84 | 1986–89 | 1991–94 | 1996–99 |
|---|---|---|---|---|---|---|
| Males | 25–77 years | CVD: | 37 | 49 | 39 | 35 |
| | | IHD | 23 | 34 | 27 | 26 |
| | | Stroke | 8 | 9 | 4 | 4 |
| | | Other CVD | 7 | 7 | 8 | 5 |
| | | Cancer: | 25 | 15 | 24 | 23 |
| | | Lung cancer | 14 | 11 | 11 | 14 |
| | | Non-lung cancer | 11 | 3 | 14 | 10 |
| | | Unintentional injury | 8 | 6 | 7 | 7 |
| | | Suicide | 2 | 5 | 4 | 6 |
| | | Chronic lung disease | 11 | 9 | 10 | 9 |
| | | Other causes | 16 | 16 | 15 | 20 |
| | 25–44 years | CVD | 32 | 32 | 22 | 18 |
| | | Cancer | 0 | 4 | 0 | 3 |
| | | Unintentional injury | 39 | 29 | 38 | 27 |
| | | Suicide | 10 | 14 | 20 | 20 |
| | | Chronic lung disease | 5 | 1 | 2 | 3 |
| | | Other causes | 14 | 21 | 19 | 29 |
| | 45–59 years | CVD | 45 | 52 | 49 | 43 |
| | | Cancer | 25 | 16 | 38 | 27 |
| | | Unintentional injury | 6 | 7 | -1 | 4 |
| | | Suicide | 2 | 6 | 0 | 4 |
| | | Chronic lung disease | 11 | 2 | 5 | 4 |
| | | Other causes | 10 | 18 | 8 | 18 |

| Sex | Age group | Cause of death | 1981–84 | 1986–89 | 1991–94 | 1996–99 |
|---|---|---|---|---|---|---|
| | 60–77 years | CVD | 36 | 53 | 42 | 37 |
| | | Cancer | 31 | 16 | 25 | 31 |
| | | Unintentional injury | 1 | -0 | 0 | 1 |
| | | Suicide | 0 | 2 | 2 | 1 |
| | | Chronic lung disease | 13 | 15 | 15 | 15 |
| | | Other causes | 20 | 15 | 17 | 16 |
| Females | 25–77 years | CVD: | 59 | 46 | 51 | 38 |
| | | IHD | 38 | 30 | 35 | 23 |
| | | Stroke | 13 | 6 | 8 | 8 |
| | | Other CVD | 8 | 10 | 7 | 8 |
| | | Cancer: | 10 | 21 | 20 | 26 |
| | | Lung cancer | 7 | 7 | 11 | 15 |
| | | Non-lung cancer | 3 | 13 | 9 | 11 |
| | | Unintentional injury | 3 | 2 | 2 | 1 |
| | | Suicide | -0 | -3 | -1 | 1 |
| | | Chronic lung disease | 12 | 12 | 9 | 14 |
| | | Other causes | 17 | 18 | 18 | 19 |
| | 25–44 years | CVD | 26 | 33 | 26 | 29 |
| | | Cancer | 21 | 62 | 27 | 18 |
| | | Unintentional injury | 3 | 4 | 19 | 12 |
| | | Suicide | 5 | -10 | 3 | 11 |
| | | Chronic lung disease | 3 | 15 | 0 | 0 |
| | | Other causes | 41 | -13 | 25 | 30 |
| | 45–59 years | CVD | 49 | 35 | 43 | 37 |
| | | Cancer | 9 | 29 | 27 | 33 |
| | | Unintentional injury | -1 | -0 | -1 | -1 |
| | | Suicide | -4 | -3 | -3 | 0 |
| | | Chronic lung disease | 21 | 17 | 11 | 9 |
| | | Other causes | 21 | 19 | 19 | 22 |
| | 60–77 years | CVD | 69 | 55 | 59 | 37 |
| | | Cancer | 8 | 12 | 15 | 28 |
| | | Unintentional injury | 3 | 2 | 0 | 3 |
| | | Suicide | -0 | -2 | -1 | -1 |
| | | Chronic lung disease | 12 | 10 | 11 | 18 |
| | | Other causes | 8 | 22 | 15 | 15 |

The major difference between the education pattern in Figure 39 above compared to the income pattern in Figure 33 is that the total SII tends to decrease over time for education compared to the stasis or increase over time for income. However, some of the key trends by cause of death evident with the income SIIs are also evident with the education SIIs.

- Cardiovascular disease is always a major contributor, although decreasing over time.
- In both absolute (Figure 39) and percentage (Table 42) terms the contribution of cancer to the education SII increases over time among females – especially for older females. However, among males the contribution of cancer to the education SII is constant over time.
- The contribution of unintentional injury is only important for males.

# Chapter 13: Ethnicity, Income, Education and Mortality

The first of the *Decades of Disparity* reports (Ajwani et al 2003) showed that during the 1980s and early 1990s Māori and Pacific all-cause mortality rates were higher than non-Māori non-Pacific rates. Further, Māori and Pacific mortality rates reduced only modestly over this period in contrast to strong reductions in non-Māori non-Pacific mortality (at least until the mid-1990s) (Ajwani et al 2003). A thorough examination of the contribution of socioeconomic position to ethnic differences in mortality, and the interaction of ethnicity with socioeconomic position, will be the major focus of the next (third) report in the *Decades of Disparity* series.

In this chapter, we seek to establish whether the association of socioeconomic position with mortality is reasonably similar between Māori and non-Māori non-Pacific ethnic groups. (The relatively small size of the Pacific population in the early cohorts meant that mortality rates for the Pacific ethnic group were too imprecise to analyse.) If the association is similar, then we can think of the results presented elsewhere in this report as applying (roughly) to both ethnic groups. But if they do vary by ethnic group, then the results mostly reflect the situation for the non-Māori non-Pacific group, who numerically dominate the analyses.

## 13.1 Ethnicity, income and mortality

Figure 40 presents all-cause mortality by ethnicity and sex. The format is similar to that presented elsewhere in this report, except that the medium- and high-income groups are combined to ensure reasonable precision for Māori. (Mortality rates for high-income Māori were quite imprecise, especially in the early 1980s.)

### 13.1.1 Is the association of income with mortality similar for Māori and non-Māori non-Pacific ethnic groups?

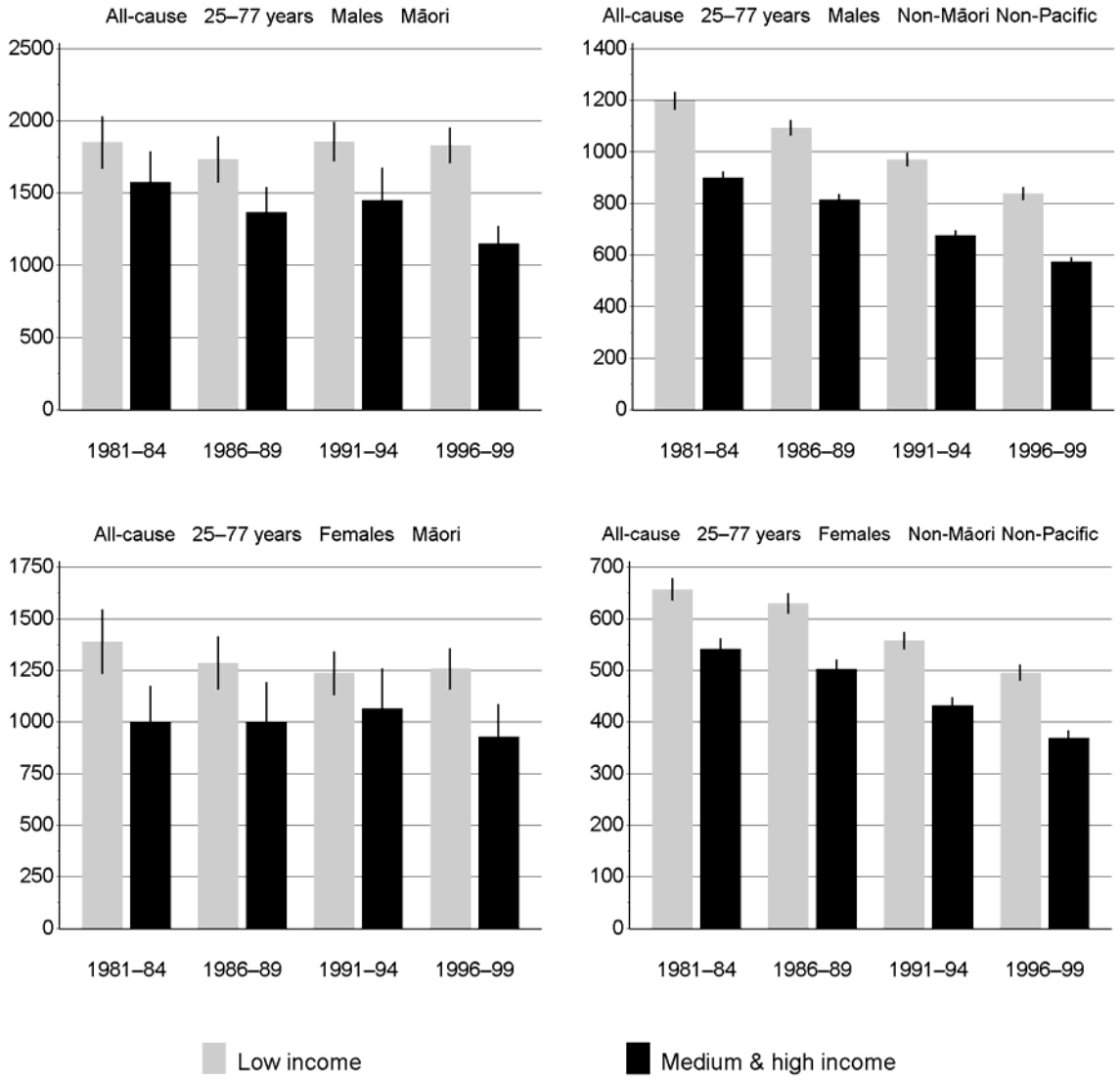
During all periods, and within both sex and ethnic groups, the mortality rates of the low-income group exceeded those of the combined medium- and high-income group. That is, in qualitative terms at least, the income–mortality association was common across ethnic groups.

Quantitatively, though, the answer depends on whether one looks at absolute (SRDs) or relative (SRRs) measures of the income–mortality association (Table 43).[6] Within each sex and period, the SRRs are reasonably comparable between Māori and non-Māori non-Pacific ethnic groups. However, the SRDs among Māori were greater than the SRDs for non-Māori non-Pacific, except for males in 1981–84.

To summarise, relative inequalities in mortality by income were similar between Māori and non-Māori non-Pacific ethnic groups, but absolute inequalities were greater among Māori.

[6] Note: We do not present SIIs and RIIs in this chapter.

**Figure 40:** All-cause mortality rates, ages 25–77 years, by ethnicity, income level, period and sex




Notes:

- Age-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 84.
- A different y-axis scale is used for each ethnic group.

**Table 43:** All-cause mortality relative and absolute measures of inequality, by income and ethnicity, 25–77-year-olds combined

| Sex | Cohort | Standardised rate ratio (95% CI) | | | | Standardised rate difference (95% CI) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Māori | | Non-Māori non-Pacific | | Māori | | Non-Māori non-Pacific | |
| Males | 1981–84 | 1.18 | (0.99–1.39) | 1.33 | (1.28–1.39) | 278 | (-3–559) | 299 | (257–340) |
| | 1986–89 | 1.27 | (1.09–1.48) | 1.34 | (1.29–1.39) | 368 | (134–602) | 280 | (244–316) |
| | 1991–94 | 1.28 | (1.08–1.52) | 1.44 | (1.38–1.49) | 407 | (145–669) | 294 | (263–326) |
| | 1996–99 | 1.59 | (1.41–1.80) | 1.46 | (1.40–1.52) | 681 | (510–851) | 264 | (234–293) |
| Females | 1981–84 | 1.39 | (1.13–1.71) | 1.22 | (1.16–1.28) | 391 | (157–624) | 116 | (87–146) |
| | 1986–89 | 1.29 | (1.04–1.61) | 1.25 | (1.20–1.31) | 289 | (56–523) | 127 | (101–154) |
| | 1991–94 | 1.16 | (0.95–1.42) | 1.29 | (1.23–1.35) | 171 | (-49–390) | 126 | (103–149) |
| | 1996–99 | 1.35 | (1.12–1.63) | 1.34 | (1.28–1.41) | 328 | (144–512) | 127 | (106–148) |

Note: Both the standardised rate ratios (SRRs) and standardised rate differences (SRDs) are for comparisons of the low-income group with the combined medium- and high-income group.

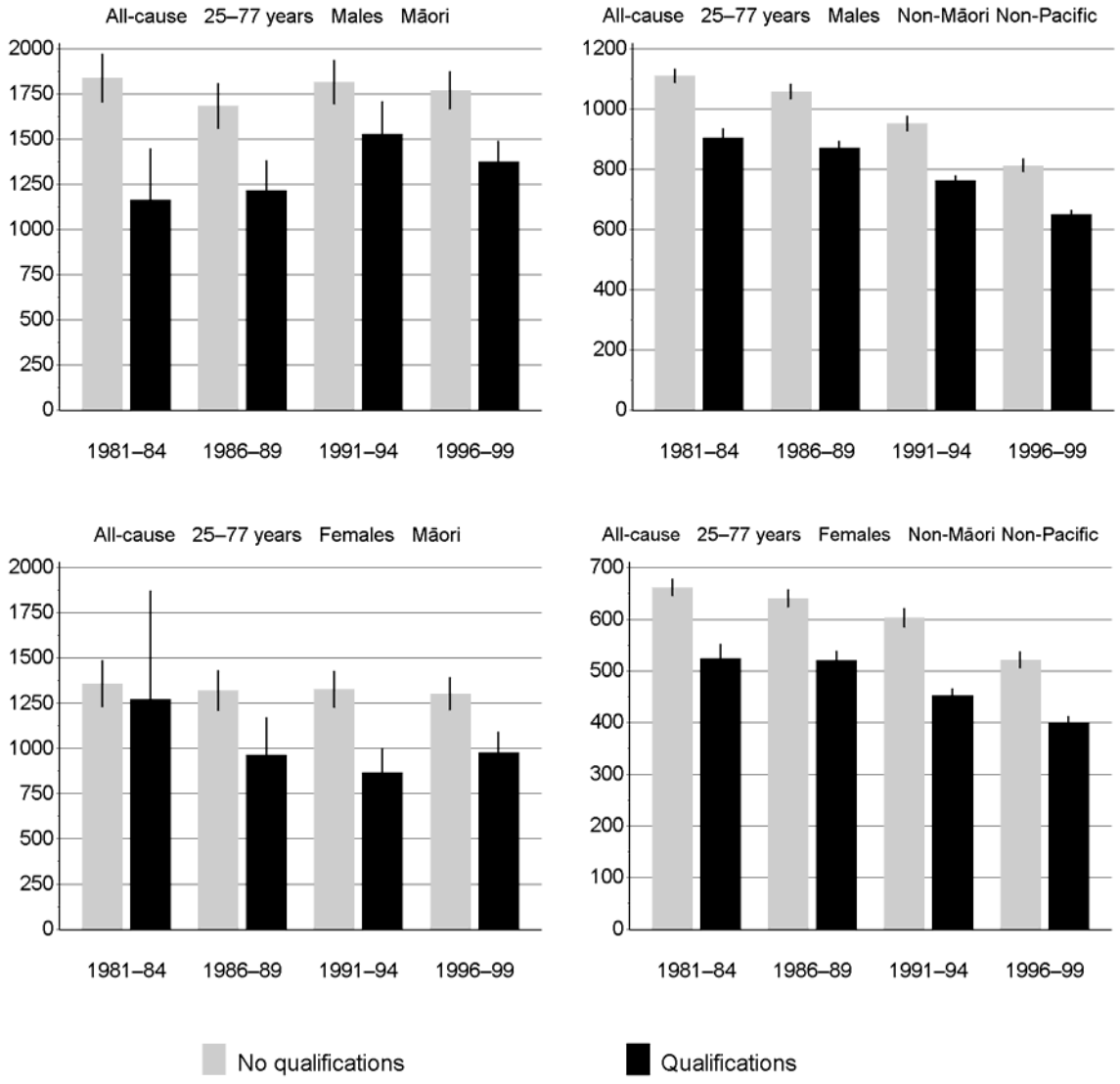
A number of other findings are also apparent from Figure 40 and Table 43, which we will investigate more thoroughly in the next (third) report in the *Decades of Disparity* series. In passing, though, we briefly note that:

- during all periods, the combined medium- and high-income Māori group had greater mortality rates than the low-income non-Māori non-Pacific ethnic group (Appendix, Table 84)
- non-Māori non-Pacific people experienced strong decreases in mortality at all levels of income. Likewise, high- and medium-income Māori males experienced a decline in mortality rates. However, this was not the case for low-income Māori males, or Māori females in all income groups, who experienced little decline in mortality rates over the four cohorts.

## 13.2 Ethnicity, education and mortality

As with ethnicity and income, there was a strong association of educational qualifications and all-cause mortality within Māori as well as non-Māori non-Pacific ethnic groups (Figure 41 and Table 44).

**Figure 41:** All-cause mortality rates, ages 25–77 years, by ethnicity, education level and period




Notes:

- Age-standardised mortality rates (and accompanying 95% confidence intervals) are presented in the Appendix, Table 85.
- A different y-axis scale is used for each ethnic group.

**Table 44:** All-cause mortality relative and absolute measures of inequality, by education and ethnicity, 25–77-year-olds combined

| Sex | Cohort | Standardised rate ratio (95% CI) | | | | Standardised rate difference (95% CI) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Māori | | Non-Māori non-Pacific | | Māori | | Non-Māori non-Pacific | |
| Males | 1981–84 | 1.58 | (1.22–2.05) | 1.23 | (1.18–1.28) | 677 | (360–993) | 206 | (167–245) |
| | 1986–89 | 1.39 | (1.19–1.62) | 1.22 | (1.17–1.26) | 469 | (261–678) | 188 | (154–221) |
| | 1991–94 | 1.19 | (1.04–1.36) | 1.25 | (1.21–1.29) | 288 | (71–504) | 190 | (159–220) |
| | 1996–99 | 1.29 | (1.16–1.42) | 1.25 | (1.21–1.30) | 395 | (241–548) | 164 | (137–190) |
| Females | 1981–84 | 1.07 | (0.66–1.73) | 1.26 | (1.19–1.34) | 87 | (-527–701) | 138 | (106–170) |
| | 1986–89 | 1.37 | (1.09–1.73) | 1.23 | (1.18–1.29) | 359 | (122–596) | 121 | (95–147) |
| | 1991–94 | 1.53 | (1.29–1.82) | 1.33 | (1.28–1.39) | 462 | (295–628) | 151 | (128–173) |
| | 1996–99 | 1.33 | (1.17–1.52) | 1.30 | (1.25–1.36) | 326 | (182–469) | 122 | (102–142) |

Note: Both the standardised rate ratios (SRRs) and standardised rate differences (SRDs) are for comparisons of the 'no qualifications' group with the 'qualifications' group.

During all periods, educational gradients in all-cause mortality were similar for both ethnic groups. There were no significant trends in SRRs or SDRs for any ethnicity by sex group.

# Chapter 14: Discussion

## 14.1 Summary and interpretation of main findings

The overall findings of this report can be summarised as follows.

- Absolute socioeconomic inequalities in mortality among males and females aged 25–77 years were stable on average over the 1980s and 1990s, whereas relative inequalities increased.
- Relative inequalities in mortality among males and females aged 25–77 years increased more using income as the measure of socioeconomic position (approximately doubling) than using education.
- Increasing socioeconomic inequalities in all-cause mortality over time were most notable among 25–44-year-olds.
- Educational inequalities in mortality tended to be greater than income inequalities among 25–44-year-olds, while the opposite was found for 45–59 and 60–77-year-olds.

### 14.1.1 Have socioeconomic inequalities in mortality increased?

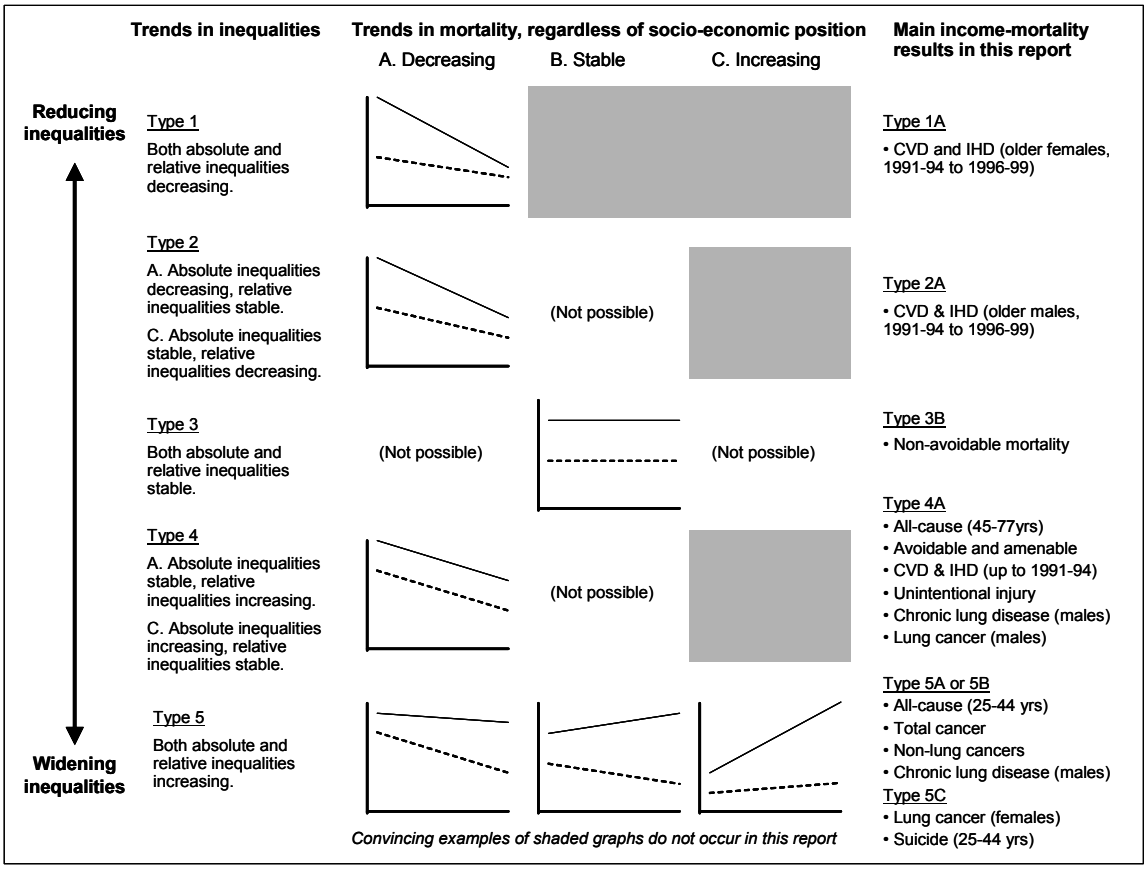
Have socioeconomic inequalities in mortality increased during the 1980s and 1990s in New Zealand? Yes – by most measures.

Figure 42 below presents a typology of trends in socioeconomic inequalities in mortality, incorporating both absolute and relative measures of inequality. The typologies range from both decreasing absolute and decreasing relative inequalities over time (Type 1) to both increasing relative and increasing absolute inequalities (Type 5). Nobody would disagree that the former represent reducing inequalities and the latter widening inequalities. However, there may be disagreement about whether or not inequalities are reducing or widening over time when the direction of change varies by absolute and relative measures of inequality. Types 2 to 4, therefore, are ordered from being more consistent with reducing inequalities to widening inequalities, respectively, when considering both absolute and relative measures of inequality as equally important.

Our typology is also cross-classified with background trends in mortality: decreasing, stable, increasing. In rich countries, a decreasing trend in mortality rates is most likely.

The main trends in inequalities in mortality by income in this report are listed on the right of Figure 42. For most breakdowns of mortality, inequalities were at the 'widening inequalities' end of the spectrum. All-cause mortality for 25–44-year-olds, mortality from cancers (excluding male lung cancer), male chronic lung disease, and suicide for 25–44-year-olds all demonstrated both widening absolute and relative inequalities (Type 5). Cardiovascular disease trends by income in the 1990s among older people fitted into typologies of reducing inequalities. Most remaining breakdowns of mortality fitted Type 4 – stable absolute inequalities, but widening relative inequalities. (Unintentional injury was difficult to fit into this typology because of the variations by sex, age, and road traffic crash versus other injury, reducing the statistical power to a point where it was difficult to make confident interpretations.)

**Figure 42:** A typology of trends in socioeconomic inequalities in mortality




Note: The graphical representations are of mortality rates on the y-axis and time on the x-axis, with low socioeconomic position plotted as the solid line and high socioeconomic position as the dashed line.

Considering education as the socioeconomic factor of interest, some breakdowns of mortality shifted the type towards the 'reducing inequalities' end of the spectrum. For example, both absolute and relative inequalities in 60–77-year-old mortality (especially females) reduced over the 1980s and 1990s. Nevertheless, the majority of the education–mortality results would still be centred on Types 4 and 5 in Figure 42 (ie, those more towards the 'increasing inequalities' end of the spectrum). By occupational class, female 25–59-year-old mortality would fit in as a Type 5, and male 25–59-year-old mortality as a Type 4.

The remainder of this section (14.1) summarises each cause of death in a little more detail, with accompanying expert commentaries.

### 14.1.2 All-cause mortality

Mortality rates tended to improve over time for all income groups in all sex-by-age groupings – except among 25–44-year-olds. In this age group only higher socioeconomic groups experienced an improvement in mortality rates.

The rate ratios for 25–77-year-olds combined, comparing low- to high-income groups, increased from 1.43 in 1981–84 to 1.72 in 1996–99 for males, and from 1.27 to 1.50 for females. The increases in relative inequalities were most pronounced among 25–44-year-old females (rate ratios increasing from 1.05 in 1981–84 to 1.69 in 1996–99, p for trend < 0.01).

Using the regression-based RII measure of relative inequality, the inequality more than doubled from 1.7 to 2.6 in males and from 1.5 to 2.2 among females.[7] This RII measure captures the total impact of income, including the underlying widening income distribution. Therefore, our findings are consistent with the hypothesis that the widening of the income distribution in New Zealand during the 1980s and 1990s exacerbated socioeconomic inequalities in mortality over this period.

Estimated life expectancy at birth increased during the 1980s and 1990s for all three income groups. Among males, the ethnically weighted life expectancy increased from 72.3 to 77.4 years among the high-income group, and from 69.2 to 74.1 years in the low-income group. Among females, the life expectancy increased from 78.6 to 81.5 years among the high-income group, and from 75.7 to 78.8 years in the low-income group. Therefore, gaps in life expectancy between low- and high-income groups widened from 3.4 to 5.0 years for males but remained stable (or even slightly narrowed) from 2.9 to 2.7 years for females.

### Invited commentary: Measures, markers, and mechanisms – perspectives from sociology and policy

*Professor Peter Davis, Sociology Department, University of Auckland*

The analysis of structured socioeconomic inequality has always held a special fascination for sociologists. Firstly, as a stratification system, it is distinctive of societies that have made the industrial transition (in New Zealand, for example, but not Tonga). Secondly, the issue of socioeconomic inequality goes to the heart of the claims of modern democratic societies to be good and fair. Thirdly, such inequalities appear to be susceptible to policy intervention. It is, therefore, very welcome to have some solid data and sophisticated analysis.

In the study of socioeconomic stratification, sociologists usually distinguish between the material aspect (standard of living), the cultural (life-style), and the political (power structures). Income – as used in this report – is a very attractive datum, both because it measures the material aspect directly, and because it is readily quantifiable and seems to have clear policy implications. Income can also be seen as a marker for cultural difference and broader power structures. This is its strength, and its weakness (how do we distinguish measure from marker?).

Even if we concentrate on income as a direct measure of material inequality, there is still the issue of mechanisms. For example, this report documents an increase in the inequality of equivalised household disposable income. Yet over this same period – the early 1990s – unemployment dramatically increased, suggesting that economic (not just income) policy influenced material inequality and that unemployment may itself have affected mortality outcomes, quite independently of lower income. Similarly, a high proportion of the low-income group consists of the non-active labour force, overwhelmingly those in retirement. Their social characteristics – and the policy context – are quite different from other low-income households, as might also be the pathways to mortality. Thus, labour force status and income are powerfully confounded, and the pathways to mortality have to be interpreted in this context.

[7] For example, among males the increase was (2.6 – 1.7)/(1.7 – 1) = 1.28; ie, a 128% increase as an RII of 1.0 is the null.

One of the strengths of this report is the way in which it is prepared to ask the really hard questions – has socioeconomically generated mortality inequality grown? – and to do so in a rigorous and analytically sophisticated way. Thus, Figure 42 is of great assistance in clarifying the various policy options. In the case of New Zealand, the dominant trend is one of decreasing mortality (column A) and the most frequently occurring empirical outcomes are Types 4 and 5. Clearly, Type 5 – particularly for amenable mortality – is undesirable, especially Types 5B and 5C (where absolute mortality rates increase for lower-income groups). Optimally, and ideally, Types 1 and 2 would be nice to have, but is Type 4 all that bad as a policy outcome, at least as a 'holding position'? I suspect that most members of the public would find acceptable a scenario of equally declining mortality for both high and low incomes (ie, Type 4), although they would undoubtedly prefer it if low-income mortality declined more rapidly (Types 1 and 2), and they would probably find unacceptable the outcomes under Type 5.

The rhetoric of the report – in keeping with the description of Type 4 – is of growing (relative) inequality. Although technically true (on a strict interpretation of absolute and relative indicators), this probably does not reconcile with the public's understanding of the matter. Furthermore, it is important to consider how realistic the various policy scenarios are. If we set policy goals that are very hard to achieve under any realistic circumstances, the academic and political debates on questions of inequality may become increasingly distanced from each other.

The estimated number of excess deaths attributable to low and medium income (compared to high-income) was approximately 3700 per year in 1996–99 (Table 12). This estimate corresponds reasonably well with the estimate of 4800 deaths per year attributable to small-area deprivation during 1996–98 (Ministry of Health 2004), especially bearing in mind that this latter estimate covers all ages (not just 25–77 years). By way of comparison, cholesterol (4700 deaths) and tobacco smoking (5000 deaths) were estimated to result in similar numbers of excess deaths (Ministry of Health 2004).

### Invited commentary: All-cause and avoidable mortality, and a high-level overview

*Alistair Woodward, School of Population Health, University of Auckland*

Ten years ago the World Bank flagged falling mortality as one of the most important social phenomena world-wide, and proposed three categories of explanation. These were rising incomes, the effects of medical technology, and education and public health programmes.

The results of the NZCMS show the decline in all-cause mortality has continued through the 1990s in New Zealand, and the rate of change shows little sign of reducing. The fall has been greater, in absolute and relative terms, among those over 60 than younger age groups, contrary to the predictions of some demographers. The fall in death rates has been particularly strong in the categories of 'avoidable' and 'amenable' deaths. This is very welcome, as it suggests that there have been strong treatment effects, either clinical or public health.

But the strength of the NZCMS, and where it makes a particularly important contribution to the world literature, is the evidence brought forward in this report that the reduction in mortality has not been evenly spread across the population.

If there was a systemic cause of mortality decline, which operated on all members of the population in the same (absolute) fashion and left untouched the socially patterned causes of the distribution of mortality, one would expect falling death rates to be accompanied by constant absolute differences and rising relative inequalities (Victora et al 2000). Here, in New Zealand, we observe stable, or even increasing (SII for income, and 25–44-year-olds) absolute inequalities, and notably increasing relative inequalities. Clearly the factors operating on mortality decline are not distributed in proportion to need (as measured by absolute mortality). Indeed, the increasing relative inequalities between income groups suggest that the inverse care law is operating more strongly than ever (greatest benefits are going to those in least need). The pattern of widening gaps is most marked in the youngest age group (25–44), where the numbers of deaths are relatively small but the losses of potential years of life are large. In this age group, there have been no gains in mortality among low-income men and women over 20 years; consequently the income–mortality gradient has steepened greatly.

What are the implications? Most importantly, the NZCMS indicates there are substantial missed opportunities to achieve the twin goals of government: improvements in overall measures of population health and reductions in inequalities. At an individual level, the potential for gains is greatest at younger ages, and this is where the inequalities are currently most strongly expressed. Moreover, the widening gaps are most apparent in the avoidable and amenable categories of death. This fits with the World Bank's view 10 years ago, and suggests that medical and public health interventions to reduce mortality may be a cause of both mortality decline (which is welcome) and widening inequalities (which are not). The challenge that lies ahead is to maintain the factors that are driving mortality down, while identifying and modifying the forces that are shaping the distribution of mortality in an increasingly inequitable fashion.

### 14.1.3 Avoidable, amenable and non-avoidable mortality

Non-avoidable mortality rates, and inequalities in these rates, remained reasonably stable over the period covered in this report. In contrast, avoidable mortality, and the subset of avoidable mortality that is amenable to health services interventions, has declined dramatically in all income groups. Given the roughly parallel decline by income in avoidable mortality rates, absolute inequalities remained stable over time but relative inequalities more than doubled. While this points to health services in the broadest sense being a major driver of decreasing mortality rates over time, it also suggests that health services may have made a substantial contribution to widening relative inequalities in mortality over the 1980s and 1990s. From another perspective, higher-income groups appear to have maintained their greater responsiveness and/or access to preventive and treatment services.

### 14.1.4 Cardiovascular disease

Cardiovascular disease mortality declined notably during the 1980s and 1990s for all income groups. These declines were roughly in parallel by income from 1981–84 to 1991–96 such that absolute inequalities (ie, SRD) were stable over this period. From 1991–94 to 1996–99, however, absolute inequalities reduced by about 15% for males and 40% for females. Why? At the most basic level of analysis, because the rate of fall in the high-income group's CVD mortality slowed over the 1990s while the low-income group's CVD mortality continued its rapid decline. While we cannot prove our assertion, it is tempting to conclude that the high-income group's CVD mortality rate is starting to plateau at a new background rate (or slower rate of decline) while low-income groups are catching up with the gains made earlier by the high-income groups. Such an interpretation is also consistent with our *a priori* expectations based on the inverse equity hypothesis (section 1.7), and (by extension) a model of CVD (particularly IHD) mortality epidemics being out of phase by socioeconomic position.

The trends in relative inequalities in CVD among 25–77-year-olds were also consistent with the above interpretation. Among males the rate ratio increased steadily from 1.38 in 1981–84 to 1.69 in 1996–99, whereas the rate ratio among females increased from 1.38 in 1981–84 to 1.54 in 1991–94, then fell to 1.40 in 1996–99. (We would expect to see peaking of absolute inequalities before relative inequalities.)

Trends in CVD rates by income were similar by age group, although it was the 60–77-year-old group where the slowing decline in the high-income group's mortality from 1991–94 to 1996–99 was most evident. As a consequence, increases in relative inequalities were most pronounced among 45–59-year-olds, with rate ratios of 2.21 (RII of 3.8) for males and 2.85 (RII of 8.4) for females in 1996–99.

Not surprisingly, the trends apparent for CVD overall were largely driven by trends for IHD.

### Invited commentary: Cardiovascular disease

*Norman Sharpe, Medical Director, National Heart Foundation of New Zealand*

During the past 35 years there has been a remarkable decline in cardiovascular disease mortality rates (both coronary heart disease and stroke) in New Zealand. Similar declines have occurred during the same period in other Western countries, although more steeply in Australia and the United States. Exact analysis of the reasons for the decline is not possible, but it has been estimated that approximately 60% of the reduction can be attributed to primary prevention, principally smoking reduction, with the remainder being related to the combined effects of medical treatments.

The modern paradigm for cardiovascular disease now views traditional risk factors as intermediary, resulting from interaction between genetic endowment and environmental factors, which in turn are strongly socioeconomically and socio-culturally determined. This model of causation ('looking upstream') is reflected in the New Zealand Health Strategy (Minister of Health 2000), which for the first time emphasised a broad social model of health with intersectoral and public policy requirements. Cardiovascular disease, diabetes and related preventive aspects are represented in six of the 13 Strategy priority objectives. Key principles underlying the Strategy include the Treaty relationship, a lifespan approach to health, focus on the disadvantaged, equitable access to care, and active involvement of consumers and communities.

This report shows that absolute socioeconomic inequalities in cardiovascular disease mortality (predominantly due to ischaemic heart disease) for men and women have remained relatively stable during the period of general decline of the 1980s and 1990s. However, relative inequalities have increased, particularly for men. The data are additional to those published last year, which showed major ethnic disparities, with mortality rates considerably higher in Māori than non-Māori/non-Pacific, and with Pacific rates intermediate. The socioeconomic disparity, which is based on income as a measure of socioeconomic position, is likely related to a complex mix of ethnic, socioeconomic, geographic (urban/rural and regional) and access-related factors.

The findings highlight the importance of the New Zealand Health Strategy principles and priority objectives, intersectoral co-operation and scrutiny of public policy. There is an urgent need to remedy these inequities by working across the health continuum from public and population health to individual clinical care and rehabilitation. The National Heart Foundation's 2003 Strategic Plan[8] has refocused priority objectives, which are well aligned with the New Zealand Health Strategy. In collaboration and alliance with many other agencies and with health care providers, and applying an 'equity lens' to project work, we are working to achieve more equitable and improved heart health for all New Zealanders.

[8] See www.nhf.org.nz.

### 14.1.5 Cancer

Mortality rates by income for all cancers combined did not change dramatically during the 1980s and 1990s – but changes were enough to give rise to a notable widening in both absolute and relative inequalities. Among males, the low-income group's rates were stable over time whereas the high-income group's rates decreased by about 20%. Among females, the low-income group's cancer mortality rate increased by about 10% and the high-income group's rate decreased by about 15%.

Relative inequalities among 25–77-year-olds increased from rate ratios of 1.28 to 1.53 among males, and from 1.09 to 1.41 among females. Absolute inequalities increased in parallel. Both lung and non-lung cancers contributed to these increasing total cancer inequalities by income. Among females, the increasing disparity in lung cancer mortality was marked, with a near doubling in lung cancer mortality among low-income females compared to modest reductions among high-income females.

Increasing cancer inequalities by education were more muted than by income, but were still apparent. A more detailed commentary on the cancer findings in this report, and possible explanations for their occurrence, are provided by Jeffreys et al in the text box below.

#### Invited commentary: Cancer

*Mona Jeffreys, Andrea 't Mannetje, Neil Pearce, Centre for Public Health Research, Massey University, Wellington*

The data presented in this report highlight inequalities in cancer mortality in New Zealand, and indicate a widening gap between rich and poor, which is particularly evident for mortality from colorectal cancer (males), and for breast cancer and lung cancer (females). These data are, in general, consistent with the international literature on inequalities in cancer (Kogevinas et al 1991), although they demonstrate some patterns that are unique to New Zealand. The overall picture is that all-cancer mortality displays a negative gradient by socioeconomic position (ie, deprivation is associated with higher mortality).

A major problem with interpreting socioeconomic differences in cancer mortality is disentangling the effects of incidence and survival. Individual-level 'life-style' risk factors affect incidence as well as prognosis of disease. Survival is also affected by access to care, including early detection and optimal treatment. Socioeconomic factors will affect mortality at each of these stages and concentrating only on mortality figures may mask where on the 'cancer continuum' socioeconomic disparities exert an effect.

Most international studies find associations between deprivation and *lung cancer* mortality in males (Kogevinas et al 1991). In women, no international study has found socioeconomic gradients in lung cancer mortality as strong as those reported for New Zealand. This reflects the more pronounced socioeconomic gradient in smoking in women than in men (Hill et al 2003). Recent lung cancer mortality figures reflect historical smoking patterns. Data on smoking prevalence by socioeconomic position indicate higher prevalence and lower quit ratios among poorer compared to more affluent people, with the differences being stronger in 1996 than in 1981 (Hill et al 2003). This indicates that the diverging patterns of lung cancer mortality will continue during the first half of the 21st century.

During the 1990s, a negative gradient in *colorectal cancer* mortality by socioeconomic position in New Zealand emerged, which was not present in the 1980s. At that time, a similar trend was already evident in white American men (Davey Smith et al 1996) but not in the UK (Davey Smith et al 1991). Numerous studies have implicated a positive energy balance and a high-fat/low-fibre diet in the aetiology of colorectal cancer (Boyle and Leon 2002), which are hallmarks of a typical Western diet. Associations between diet and colorectal cancer are unlikely to be strong enough to explain the observed trends. The observed differences in mortality across socioeconomic groups are likely to be influenced by socioeconomic inequalities in survival from colorectal cancer. Such inequalities are present in New Zealand (Personal communication, V Stevanovic, New Zealand Health Information Services, February 2004) as well as in the UK (Coleman et al 2001).

Traditionally, *breast cancer* has been considered to be a disease of the rich, one of the few cancers to show higher rates in more affluent people. Several studies found this positive socioeconomic gradient in the middle of the 20th century (Kogevinas et al 1997). In the New Zealand data, a negative socioeconomic gradient became apparent in the most recent cohort. This could be due to changes in underlying risk factors, the most obvious candidate of which may be being overweight, which is associated with higher risks of post-menopausal breast cancer (Calle et al 1999). Levels of obesity have escalated in New Zealand in recent years (Ministry of Health 2002a) and the obesity epidemic probably had its origins many decades previously (Okasha et al 2003). Based on the reproductive risk factor profile of women in lower socioeconomic groups (later menarche, earlier age at first birth, more children), one would expect these women to experience a lower disease incidence, which is not the case in New Zealand (Ministry of Health 2002b). Differential uptake of breast cancer screening across socioeconomic groups may widen inequalities in breast cancer mortality. In New Zealand, data on uptake by socioeconomic group are not available, but uptake does differ by ethnicity; eg, 41% of eligible Māori and Pacific women attended screening mammography compared to 63% of non-Māori, non-Pacific women in 2003 (National Screening Unit 2003).

The data on *prostate cancer* mortality indicate higher mortality among poorer people at most time periods. International studies have found no consistent pattern between prostate cancer mortality and socioeconomic position (Faggiano et al 1997). Interpretation of the data is complicated by the use of opportunistic screening for prostate cancer, which is thought to be widespread in New Zealand (National Health Committee 2003). Screening inflates incidence data through enhanced detection, but the effect of prostate cancer screening on mortality is unknown (Frankel et al 2003). If uptake of screening is socially patterned and does reduce mortality, inequalities in prostate cancer mortality could result.

What drives such inequalities in health? Socioeconomic position is itself not a cause of disease or survival, but a proxy measure for a set of (partially unidentified) causes. It is well established that poor people are more likely to be exposed to risk factors such as smoking. Although this is often described as a 'life-style choice', such choices are made within the constraints and context within which people live. It is no accident that disadvantaged people, who are often struggling to survive from week to week, smoke more, find it harder to give up, have less healthy diets, and exercise less.

Other risk factors for cancer are even less subject to choice. Occupational exposure to carcinogens tends to be concentrated among manual workers and in disadvantaged socioeconomic groups. It has been estimated that occupational cancer is responsible for about a third of the difference in total cancer and half of the difference in lung cancer mortality between high and low social classes in England and Wales (Boffetta et al 1997). How much occupational exposures contribute to cancer mortality in New Zealand is currently not known.

It is likely that part of the difference in cancer mortality is also attributable to differences in affordable access to optimal and appropriate health care, including preventive health measures such as breast and cervical cancer screening. Sub-optimal treatment appears to explain the differences between Māori and non-Māori in terms of asthma mortality (Ellison-Loschmann et al 2002). Similar problems may exist for cancer treatment, which could explain some of the observed differences in cancer mortality across income groups.

To address the demonstrated differences in income inequalities in cancer mortality in New Zealand, we need to understand more clearly where in the chain from causation to death the inequalities play their role. People make decisions about their lifestyles, and about seeking health care, but they make these decisions within the constraints of their socioeconomic context. An understanding of the origins of health inequalities cannot be reduced to the social patterning of life-style choices. A cancer control strategy must address both inequalities in society and the resulting inequalities in access to appropriate health care. Without this, the demonstrated widening gaps between rich and poor will continue to increase, fuelling a vicious circle of deprivation and ill health in future generations.

### 14.1.6 Unintentional injury

Trends for unintentional injury varied by sex, age and road traffic crash versus non-road traffic crash deaths. Inequalities in injury mortality by income at any one point in time were most pronounced for 25–44-year-old road traffic crash mortality (rate ratios ranging from 1.58 to 2.22). However, there were no clear trends over time in inequalities in unintentional injury mortality. The commentary below by Connor throws some light on why this complex picture for unintentional injury may arise.

#### Invited commentary: Unintentional injury

*Jennie Connor, School of Population Health, University of Auckland*

There has been a major decline in mortality from unintentional injuries in New Zealand over the last 20 years, which is clearly shown in these data. Much of this improvement has been achieved through prevention of road traffic fatalities and improving survival following falls in the elderly, with benefits for men and women of all age and income groups. However, these data also demonstrate an overall negative association of injury mortality with income level that has not measurably improved over time.

The literature in this area is very sparse but demonstrates socioeconomic gradients in injury mortality for most SES measures, most population groups and most settings that have been studied. A New Zealand cohort study of predominantly male employees reported an association of driver injury with both educational and occupational status, but not neighbourhood income (Whitlock et al 2003). Two recent studies from the US (Cubbin et al 2000; Steenland et al 2003) found broadly similar results to the NZCMS, with a clear graduated association of socioeconomic status with overall injury mortality in men that was less strong and less consistent in women. Regarding motor vehicle deaths alone, several studies have shown a strong gradient for men but not for women, in whom excess mortality was only observed in the lowest SES group (Cubbin et al 2000; Steenland et al 2003; Braver 2003).

The NZCMS is breaking new ground with age- and sex-specific analyses of these relationships, and the heterogeneity they demonstrate is informative and challenging. Some of the differences can be explained by variation in the dominant external causes of fatal injuries in different age and sex groups, and the degree to which the major risk factors for these are socially patterned.

In all age and sex groups road traffic injuries and falls account for the majority of unintentional injury deaths, but road traffic injury dominates in younger people while deaths from fall-related fractures are more important in the elderly (Injury Prevention Research Unit, n.d.). Not only does the mix of external causes vary with age, but so do the predominant risk factors. For both major cause groups, road traffic and falls, the proximate risk factors in young people such as alcohol and risk-taking behaviour are strongly socially determined, whereas age-related impairments and physical fragility, which contribute to mortality in the elderly, are not.

The degree to which different income groups are exposed to the risk of an injury is also an important consideration, especially for road traffic injury. The average amount of driving by women in different income groups (due to differences in access to a car, for example) may vary sufficiently to obscure a gradient that would be apparent in an analysis of deaths per million kilometres rather than per year. Likewise, the positive relationship of road traffic mortality with income in elderly women may be simply due to the greater amount of driving done by those of high SES compared with low SES in this group.

When all unintentional injuries are aggregated, an overall social gradient in mortality is largely determined by the contribution of young to middle-aged men, with high mortality rates resulting from risk behaviours with a socioeconomic pattern. For other groups in the population, interpretation is more difficult, due to the combination of deaths from different external causes, the lack of denominators that are appropriate for road traffic injury and, in some cases, low event rates.

### 14.1.7 Suicide

Suicide rates, and the associated trends in inequalities, varied by sex and age. Inequalities were greatest among 25–44 and 45–59-year-olds, with up to three-fold higher suicide rates among low- compared to high-income people at points during the 1980s and 1990s. Both absolute and relative inequalities in suicide increased markedly during the 1980s and 1990s among 25–44-year-olds, due largely to more pronounced increases in suicide rates among low-income 25–44-year-olds.

#### Invited commentary: Suicide

*Sunny Collings, Department of Psychological Medicine, Wellington School of Medicine and Health Sciences, University of Otago*

There are socioeconomic inequalities in the distribution of suicide mortality in New Zealand, and they vary by age and sex, and have increased over time for both men and women (especially 25–44-year-olds).

The absence from this report of the data on suicide among those aged under 25 years throws into relief the less dramatic – but still important – changes in suicide rates in older age groups. Because of the steeply increasing rate among 15–24-year-olds during the 1990s, there has been a policy and prevention focus on this group (Skegg 1997; Collings 2003). In fact, much of the increase in suicide rates among 'youth' during the 1990s was due to an increase among those aged between 20 and 24 years, and the greatest number of suicides continued to occur among those aged between 25 and 44 years, particularly men. Suicide accounts for almost one-third of all-cause mortality among men aged between 20 and 35 in New Zealand (Beautrais 2003). Since the 1970s there has been a steady increase in the total male suicide rate in New Zealand, a pattern upon which recent increases are superimposed. Rates for women have been more stable (Beautrais 2003; Deavoll et al 1993).

Current mental illness is the most important proximal risk factor for suicide (Fergusson et al 2003; van Heeringen et al 2000). Ninety percent of those making medically serious attempts or dying by suicide are found to be suffering from a mental disorder at the time of the attempt (Beautrais 1998, 2002; Beautrais et al 1996). Therefore the role of mental illness is essential to any account of social variations in suicide rates.

What then is the relevance of social conditions to suicide rates? Firstly, social conditions may act as part of a 'sea' of contextual factors that shape attitudes and behaviours relating to suicidal thinking and acts of self-harm, and to other known risk factors such as substance abuse. The powerful demonstrated effect of media transmission of suicidal behaviour attests to this (Schmidke and Schaller 2000). The cultural transmission of values and beliefs about suicide may also fall into this category. Secondly, social conditions may, over time, shape the biological and psychological predisposition to mental illness or suicidal behaviour, via direct effects on physiological and biochemical mechanisms in the human body and brain (van Heeringen et al 2000). Thirdly, social conditions themselves may act as proximal risk factors, or triggers for suicide, interacting with existing psychological attributes of the individual to produce suicidal thinking and behaviour.

Although we know little about the current distribution of mental illness in New Zealand, in countries similar to New Zealand mental illness is more concentrated among those with the least social and financial means, in part because those with least means may have prolonged episodes of illness due to reduced access to effective treatment (Weich et al 1997). Many risk factors for mental illness are also patterned by social position, and access to services is known to be profoundly shaped in this way too. As with mortality rates from physical illnesses, it is likely that the widening socioeconomic disparity in suicide deaths reflects a widening disparity in the antecedent and contextual factors which increase the risk of mental illness.

The data here also present a stark reminder that even in the context of the improvements in mental health services that occurred in New Zealand during the 1980s and 1990s, which were supposed to ensure care for those with the most severe illness and the highest risk of death, the burden of death by suicide was increasingly borne by the most disadvantaged New Zealanders.

### 14.1.8 Contribution of causes of death to total inequality

Cardiovascular disease (CVD) made the largest contribution to the total socioeconomic inequalities in mortality. Approximately 40% of the total male inequality in 25–77-year-old mortality for both income and education was due to CVD throughout the 1980s and 1990s. Among females, however, the contribution of CVD to the total inequality reduced significantly from over half to about a third. Cancer mortality contributed to approximately a quarter of the total socioeconomic inequality among males, whereas its contribution among females increased during the 1980s and 1990s from about 10% to about 30% (more according to income, less according to education). This increase was evenly spread between lung and non-lung cancers. The contributions of unintentional injury and suicide to the total male inequalities were about 5% each – perhaps a little more for injury. However, their contribution to overall female inequality was negligible. Chronic lung diseases (mostly chronic obstructive pulmonary disease) made up 10% to 15% of the contribution for both males and females.

The fact that CVD was a major reason for the socioeconomic inequalities in mortality in New Zealand is consistent with cross-national comparisons in Europe (Mackenbach et al 2003). Also consistent with that European study, CVD in New Zealand was a major driver of the increasing relative inequality in mortality among males. What this New Zealand research adds is that other causes of death are also important drivers among males (cancer, respiratory, unintentional injury), and that among females cancer had become the leading driver of the income gradients in mortality by 1996–99. When measured in terms of life expectancy, cancer was equal with CVD as a contributor to the partial life expectancy gaps by income among females, and approaching the contribution of CVD to the mortality differences by education among females.

Projecting into the future, the contribution of cancer to inequalities may further increase to overtake the contribution of cardiovascular disease among both sexes. This prediction may be overturned if the obesity epidemic causes a reversal of the falling rates of cardiovascular disease mortality among (particularly) low socioeconomic groups.

## 14.2 Study strengths and limitations

The strengths of the NZCMS include its full coverage of the population and the coverage of a period of major change in New Zealand society – the 1980s to 1990s. Despite its full population coverage, analyses for some causes of death, or by sub-populations, run into statistical power problems, because mortality is an uncommon event.

The NZCMS data set is formed by the anonymous and probabilistic record linkage of census and mortality data (Blakely 2002; Blakely et al 2000; Blakely and Salmond 2002; Hill et al 2002). Because the linkage was unable to use text fields for name and address, we were reliant on geocodes for the usual address (meshblock codes (approximately 100 people live in a meshblock) or area units (approximately 2000 people)), sex, date of birth, country of birth and ethnicity to undertake the linkage. The geocodes were critical, since any coding errors in the geocodes on either the mortality or census data, or people moving between census night and death (with no alternative address on their administrative health data) rendered the linkage of the true census–mortality pair impossible. Likewise, more than one error on any of sex, or the day, month or year of birth, made linkage unlikely. Nevertheless, we successfully linked over 70% of mortality records for people aged 0–74 years on census night with a census record. This linkage rate improved with each cohort, such that it was near 80% in the 1996–99 cohort. Elsewhere, we have calculated that over 98% of linkages were true linkages (Blakely and Salmond 2002). Put in epidemiological terms, the positive predictive value of the linkage as a 'test' of the mortality outcome was greater than 98%, but its sensitivity was between 70% and 80%.

Linkage bias will arise in our results if the linkage success varied by socioeconomic position. Put in epidemiological terms again, we would have differential misclassification bias of the mortality outcome if the sensitivity of the linkage was differential by the socioeconomic exposure(s). Elsewhere we have shown that after allowing for differential linkage success by age (lowest for 15–24-year-old deaths) and ethnicity (lowest for Māori and Pacific deaths), decedents from more socioeconomically deprived neighbourhoods were 5–10% less likely to be linked than decedents from the least socioeconomically deprived neighbourhoods (Blakely et al 2000). To rectify this remaining bias, we calculated weights to adjust for linkage bias (Fawcett et al 2002). For example, if 10 out of 15 deaths among Māori male 45–64-year-olds living in moderately deprived neighbourhoods were linked to a given census, then each of the 10 linked census records was assigned a weight of 1.5 (ie, 15/10) to make them representative of all 15 deaths. Having applied these weights, we do not believe there will be substantive residual and systematic linkage biases in the NZCMS analyses presented in this report. Should there be any small remaining *systematic* bias, it is likely to be common to all four census cohorts (given their near identical development), meaning that comparisons across the four census cohorts (the main objective of this report) are still valid.

## 14.3 Causal association of socioeconomic factors with mortality

This report largely presents mortality rates by income, and some results by education and occupational class. All results are standardised for two important potential confounders of the association of socioeconomic position with mortality: age and ethnicity. However, we do not adjust for other likely confounders. For example, education (acquired early in adulthood) is likely to affect health via pathways other than income (eg, knowledge), while at the same time education partly determines income, and is therefore a confounder of the income → mortality association. Many other variables that we had no data on (eg, personality (Poulton and Caspi 2003; Pulkki et al 2003), early childhood circumstances) are also potential confounders. Conversely, variables that we did have data on are both potential confounders *and* potential intermediary variables (eg, smoking in the 1981 and 1996 censuses).

Elsewhere we have considered the issue of confounding of the income–mortality gradient by other socio-demographic factors, including the problematic variable of labour force status (which is also a proxy for health status) (Blakely et al in press). Our conclusion was that much (perhaps at least half), but not all, of the income–mortality association was due to confounding.

Does this confounding of the income–mortality association, and indeed those for education and occupational class, invalidate the trends included in this report? No. There is a huge amount of evidence that socioeconomic factors 'get under the skin' to cause disease, via a range of mechanisms (Berkman and Kawachi 2000; Marmot and Wilkinson 1999; Leon and Walt 2001). More specifically to this report, notable changes over time in the association of socioeconomic factors with mortality are unlikely to be purely due to changing degrees of confounding.

However, there are two important limitations with income.

- The 'crude' association of income with mortality as presented in this report will be greater than the causal association. Many other factors are correlated with income and health that will spuriously inflate the income–mortality association (ie, confounding). Put another way, a change in income will cause a smaller change in mortality than the results in this report suggest. However, such confounding would apply to any socioeconomic factor.
- Income is notoriously difficult to measure. Further, census data are income for the year proceeding census night – not necessarily one's average or usual lifetime income. These 'measurement errors', in contrast to the above confounding, will mean that we tend to *underestimate* the income–mortality association.

Regarding change over time, we have reanalysed the association of income and education with mortality presented in this report – but with the analyses restricted only to the employed subpopulation.[9] In so doing, we specifically remove the impact of one major confounder of the associations of income and education with mortality, *and* address some of the issues of reverse causation. (That is, people whose income drops due to poor health will usually also exit the labour force. Therefore, an analysis restricted to the active labour force is one way to address reverse causation.) As would be expected, the association of both income and education with mortality was weaker among the active labour force. There was also some evidence that the income–mortality association reduced more than the education–mortality association – either due to labour force status being a more important confounder of the income–mortality

[9] Results available from authors, or see Blakely et al in press.

association, or due to the removal of some reverse causation captured in the crude association of income with mortality. One problem, however, with adjusting for labour force status is that we may over-adjust, because labour force status acts to some extent as a proxy for health status – and the latter variable is clearly on the pathway from income to mortality rather than being a confounder. But most importantly, the findings presented in the body of this report on increasing relative inequalities in mortality by income (or education) persisted despite restricting the analysis to the employed subpopulation. Thus, we are confident that the changes over time in mortality inequalities presented in this report are reasonably robust.

Further, analyses conducted elsewhere (Jackie Fawcett, PhD in progress) demonstrate that excluding the first year of deaths after each census night has little impact on the results – except for a slight drop in the RII by income for 1996–99. This exclusion of deaths in the first year of follow-up is another way to investigate possible reverse causation. If the income gradient was really inflated due to reverse causation, one would expect this inflation to be greatest for deaths occurring soon after census night. Thus, while there is some evidence of reverse causation inflating income gradients as presented in this report, its overall impact is not large.

## 14.4 Comparing income to educational differences in mortality

Focusing upstream on the socioeconomic determinants of health, this report does define some interesting and useful differences in the association of income and education with mortality. First, at younger ages mortality was more strongly associated with education, and at older ages it was more strongly associated with income. One possible explanation for this pattern includes education being a temporally closer marker of socioeconomic position to deaths in early adulthood. Further, young adults are likely to have attained their full education qualifications, but not necessarily their full income earning potential.

Second, over time the relative inequalities by income increased more than they did by education – whether using the rate ratios comparing fixed income categories or the relative index of inequality using income rank. One explanation for this change is that income is becoming the more important axis of inequality to which mortality inequalities are aligned. This is not to say that education and occupational class are unimportant – if nothing else, they are both major determinants of income.

Third, the greater increases in the relative index of inequality than in the standardised rate ratio as measures of the association of socioeconomic position with mortality point to the likely exacerbating effect of New Zealand's widening income distribution on socioeconomic inequalities in mortality.

## 14.5 What explains trends in socioeconomic mortality gradients?

At the most basic level of analysis, trends in socioeconomic mortality gradients are explained by trends in mortality rates themselves within each socioeconomic group (ie, as shown in Figure 42 at the beginning of the Discussion). At a range of other levels, the expert commentaries in this chapter also offer a range of possible explanations.

Many researchers and commentators have provided frameworks to understand how socioeconomic inequalities in mortality arise at any one point in time (Berkman and Kawachi 2000; Marmot and Wilkinson 1999; Turrell et al 1999; Dahlgren and Whitehead 1991) and related frameworks for intervening to reduce inequalities in health (Ministry of Health 2002; Dahlgren and Whitehead 1991; National Health Committee 1998; Mackenbach and Bakker 2002). These frameworks typically move from global factors (eg, international trade) to individual socioeconomic position (eg, income and education), then posit a range of pathways from socioeconomic position to health (eg, material, psychosocial, behavioural and health services), and may include a layer of physiological responses (eg, cholesterol, hypertension) (Turrell et al 1999). It is neither necessary nor within the scope of this report to represent these frameworks here.

Rather, the relevant question for this report is: what trends in these explanatory factors may have given rise to the trends in socioeconomic mortality gradients described in this report?. This question is challenging because it requires both an understanding of the aetiology of socioeconomic inequalities in mortality *and* knowledge of trends *by socioeconomic position* in these explanatory factors in New Zealand during the 1980s and 1990s.

### 14.5.1 Structural explanations

In the 1950s and 1960s New Zealand society fared well. New Zealand's agricultural economy performed well on the international stage, in large part due to a privileged position as supplier of butter, meat and wool to Britain, lasting until Britain entered the European Economic Community in 1973 (Belich 2001). A strong and growing economy underpinned a strong welfare society with reasonably good access to health and other services.

New Zealand society changed dramatically in the 1980s and 1990s, with 1984 often identified as the major turning point. In the decade or so leading up to 1984, New Zealand's economy struggled with falling terms of trade and double-digit inflation. In response, from 1984 to the early 1990s, New Zealand underwent major social and economic changes, including the introduction of a substantially flattened tax system, fully targeted income support, introduction of a regressive consumption tax, market rentals for housing, privatisation of major utilities, user charges for health, education and other government services, and a restructured labour market designed to facilitate 'flexibility' (Mowbray 2001; Belich 2001; Cheyne et al 1997; Boston et al 1999). These policies were an extreme example of the neoliberal and new-right agenda embraced by many countries during the 1980s and 1990s. The resulting social and macroeconomic changes weighed particularly heavily on lower socioeconomic groups, and on Māori and Pacific peoples (Statistics New Zealand 1999; Mowbray 2001; Howden-Chapman and Tobias 2000; Te Puni Kōkiri 2000). It has previously been speculated that this economic restructuring may have contributed to New Zealand's life expectancy falling behind that of its neighbour Australia from the 1970s onwards (Woodward et al 2001; O'Donoghue et al 2000). These changes in New Zealand society were also associated with a rapid increase in income

inequality from the late 1980s to early 1990s (Statistics New Zealand 1999; Mowbray 2001), exacerbated by the welfare cuts of 1991. All in all, the relative gaps in access to economic resources between higher and lower socioeconomic groups widened during these two decades.

It seems highly likely, based on what we know internationally and nationally about the determinants of health, that the increase in social inequalities during these two decades translated into widening health inequalities. Put another way, had social inequalities not widened during the 1980s and 1990s, socioeconomic inequalities in health may not have widened either. However, observing trends in just one country (as is the case in this report) it is impossible to prove this hypothesis empirically. Instead, cross-national comparisons that involve more than one country can throw light on this issue. Howden-Chapman and Mackenbach, and Turrell, make some observations in the two expert commentaries below on international comparison generally, and on comparisons with Australia in particular.

### Invited commentary: How does New Zealand compare internationally?

*Associate Professor Philippa Howden-Chapman, Department of Public Health, Wellington School of Medicine and Health Sciences, University of Otago*

*Professor Johan Mackenbach, Department of Public Health, Erasmus University, Rotterdam*

How well and how long one lives is powerfully shaped by one's place in the hierarchies built around occupation, education and income (Graham 2000). This predictable pattern raises a crucial political and philosphical concern: how can we ensure everybody shares equally in health gains, regardless of the overall performance of the economy?

As in other OECD countries life expectancy has been rising steadily in New Zealand, but as this important report demonstrates, relative health inequalities as measured by income were increasing up until 1996, the date of the last Census included. This is not altogether surprising, as in the preceding two decades there was an unprecedented deregulation of the New Zealand economy. Income is a key indicator in market economies and as fewer goods and services are provided through the public sector, individual income becomes a more important determinant of health (Marmot 2002).

This report examines the predictability of these relationships; as overall mortality rates reduce, if absolute inequalities remain stable, relative inequalities inevitably increase. Conversely, if relative inequalities increase, absolute inequalities must increase more. But should policy makers be more concerned with absolute measures of health inequality, which indicate the actual magnitude of health disparities, or relative measures of the size of the disparity? This is also a key research and policy issue in Europe, where research has consistently shown that the more comprehensive Scandinavian welfare states have lower absolute health inequalities than liberal states, but paradoxically higher relative inequalities between different socioeconomic groups. The received wisdom is 'that all policy decisions should be based on absolute measures of risk: relative risk is strictly for researchers only' (Rose 1991), but given the public health patterns of ethnic disadvantage in New Zealand, policy makers and researchers are increasingly emphasising relative disadvantage (Ministry of Health 2002).

True to expectations in New Zealand, as absolute inequalities in mortality were stable over the last two decades, or at most showed a modest increase, relative inequalities have increased, although more in relation to income than education. Using the relative index of inequality initially developed to take account of different measures of socioeconomic disparity across different European countries, the index measures of relative inequality were even more marked than measures that do not take account of changing social and household patterns over time. For example, women in New Zealand are particularly over-represented in the bottom quintile group, which has shown an absolute drop in real income over this period.

These New Zealand findings mirror the results (as measured by education and occupation) seen in most European countries (Mackenbach et al 2003; Kunst et al 1998). Mortality rates in both New Zealand and the European countries among less advantaged socioeconomic groups are typically about twice those of higher socioeconomic groups. The widening relative gap is in most cases due to a proportionally faster decline in mortality among higher socioeconomic groups. Furthermore, the causes of death in New Zealand mirror those Northern European countries from which most colonial migrants came to New Zealand, which suggests that lifestyle factors such as smoking and diet are important contributory factors.

Overall, the most compelling explanations for the widening relative inequalities are likely to relate to the outcomes of broad policy initiatives like employment and welfare policies. Since a low point in economic performance in 1999, terms of trade have been very favourable in New Zealand compared to Europe: GDP has increased, unemployment has dropped to historically low levels and labour force participation has increased to high levels.[10] These economic and social changes could lead in the future to a greater decrease in absolute inequalities compared to countries with poorer economic performance. Relative inequalities should decrease, as relatively full employment provides more opportunities for those with less education, and high demand for labour lifts wages. Still, conventional social patterns are likely to mean that women and young people are less likely to share in these economic gains.

## Invited commentary: How does New Zealand compare with Australia?

*Dr Gavin Turrell, School of Public Health, Queensland University of Technology, Brisbane*

During the 20th century the health of the Australian population improved markedly: the toll of infectious disease was reduced sharply, life expectancy at birth continued to increase, since the late 1960s death rates from coronary heart disease and stroke have declined, and in more recent years we have witnessed a downward trend in deaths from lung, colorectal and breast cancer (Australian Institute of Health and Welfare 2000; Mathers et al 1999). Against this backdrop of overall improvements in population health, however, are large mortality inequalities between socioeconomic groups (Turrell and Mathers in press; Turrell et al 1999). In terms of relative inequalities, these differences between socioeconomic groups have widened for all causes of death combined, and for many specific causes such as CVD, cancer, and accidents and injury (Turrell and Mathers 2001). Similar trends have been observed in the US (Feldman et al 1989; Pappas et al 1993), Great Britain (Marang-van de Mheen et al 1998; Marmot and McDowall 1986; Phillimore et al 1994) and Europe (Dahl and Kjaersgaard 1993; Jozan and Forster 1993; Borrell et al 1997; Regidor et al 1995). Now on the evidence of this present report it is clear that New Zealand too is also (and has long been) characterised by marked and widening mortality inequalities between socioeconomic groups.

[10] See www.treasury.govt.nz/mei.

Recently, Queensland University of Technology and the Australian Institute of Health and Welfare completed an analysis of socioeconomic mortality inequalities in Australia (Draper et al 2004) and it is interesting to see many parallels in the findings of this work vis-à-vis the evidence documented in this New Zealand report. Table 45 presents a small selection of data from the Australian study. Although for a range of reasons the Australian and New Zealand findings cannot be compared directly, the broader patterns in the Australian data clearly show some similarities with the New Zealand evidence presented earlier, including declining absolute rates for all socioeconomic groups over time, widening relative inequalities, faster reductions in death rates among high SES groups, and growing absolute mortality inequalities for all cancers. An additional feature of the Australian data is the narrowing of absolute mortality inequalities for all causes and CVD for males and females over the two periods. These patterns contrast somewhat with the New Zealand findings, which show stable (or increasing) absolute differences in death rates for all causes between
1981–84 and 1996–99 (see Table 10 of this report), and stable absolute mortality inequalities for CVD up until the mid-1990s, followed by a suggested narrowing of the inequalities in more recent periods (see Table 10 of this report).

While the monitoring efforts in Australia and New Zealand provide essential data on the nature and extent of mortality inequalities in each country, and trends over time, the work represents only one link in a much larger chain of events that will be necessary if we are to make measurable advances in narrowing health inequalities. Significant among the challenges is the improvement of our knowledge and understanding about the genesis and persistence of mortality inequalities, which at present is limited. Possibly even more challenging, however, is the development of policies, interventions and other initiatives to reduce the inequalities, and to convince governments of the need to do so.

**Table 45:** Mortality inequalities, by area-based socioeconomic disadvantage in Australia, males and females aged 25–64 years, 1985–87 and 1998–2000

| Cause of death | Socio-economic group | Males | | | | | | Females | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1985–87 | | | 1998–2000 | | | 1985–87 | | | 1998–2000 | | |
| | | Rate* | RR | Rate diff* | Rate* | RR | Rate diff* | Rate* | RR | Rate diff* | Rate* | RR | Rate diff* |
| All | High | 338 | 1.00 | – | 219 | 1.00 | – | 190 | 1.00 | – | 137 | 1.00 | – |
| | Middle | 450 | 1.33 | 111 | 327 | 1.50 | 108 | 236 | 1.24 | 46 | 177 | 1.30 | 40 |
| | Low | 569 | 1.68 | 230 | 382 | 1.75 | 164 | 286 | 1.50 | 96 | 207 | 1.51 | 70 |
| CVD | High | 126 | 1.00 | – | 49 | 1.00 | – | 41 | 1.00 | – | 18 | 1.00 | – |
| | Middle | 167 | 1.33 | 41 | 81 | 1.65 | 32 | 66 | 1.60 | 24 | 29 | 1.64 | 10 |
| | Low | 208 | 1.65 | 82 | 103 | 2.10 | 54 | 81 | 1.97 | 40 | 41 | 2.15 | 23 |
| Cancer | High | 118 | 1.00 | – | 79 | 1.00 | – | 103 | 1.00 | – | 79 | 1.00 | – |
| | Middle | 139 | 1.18 | 21 | 106 | 1.34 | 27 | 106 | 1.04 | 4 | 87 | 1.22 | 9 |
| | Low | 151 | 1.28 | 33 | 115 | 1.45 | 36 | 113 | 1.10 | 10 | 92 | 1.31 | 13 |

Source: Draper et al 2004

Notes: High, middle and low socioeconomic groups correspond to quintiles (20%) of the Australian population based on the Australian Bureau of Statistics' Index of Relative Socioeconomic Disadvantage (1998).

* Mortality rates and rate differences per 100,000 persons.

### 14.5.2 Health behaviours

There is unfortunately an absence of repeated health behaviour survey data in New Zealand that would allow a robust determination of trends in traditional life-style factors by socioeconomic position during the 1980s and 1990s.

We do, however, have good data on trends by socioeconomic position in tobacco smoking in New Zealand from comparisons of the 1981 and 1996 census (and the 1989 Life in New Zealand Survey) (Hill et al 2003; Borman et al 1999). The one-line summary of this data is that absolute differences in current smoking prevalence between socioeconomic groups remained constant over the 1980s and 1990s, but relative inequalities increased due to background downward trends in smoking prevalence. This is a similar pattern to that observed for mortality in this report.

There are also strong leads in this report that tobacco consumption is one driver of increasing socioeconomic mortality gradients. In particular, the increasing inequalities in lung cancer and chronic lung disease (especially among females) demonstrate the importance of tobacco in the production of inequalities.

While tobacco is undoubtedly important, it is far from a full explanation for socioeconomic disparities in mortality. First, in this report we find increasing socioeconomic differences for non-lung cancer as well as for lung cancer (the major tobacco-related cancer). Second, work to be published elsewhere using the NZCMS (which includes smoking data in the 1981 and 1996 cohorts) demonstrates that strong socioeconomic gradients in mortality persist among never smokers, and that smoking probably only explains (at most) about a quarter of the socioeconomic differences in mortality.

Beyond tobacco, we can only speculate about the importance of varying trends in other behavioural risk factors and how they might have given rise to varying trends in mortality by socioeconomic position. Jeffreys et al provide a synopsis of some of these speculations with regard to cancer mortality trends on page 112.

### 14.5.3 Health services

The findings in this report suggest that health services are an important contributor to socioeconomic inequalities in mortality. For example, gradients were steepest in avoidable and amenable mortality.

Improving the effectiveness of medical treatments for life-threatening diseases creates the potential for increasing socioeconomic and ethnic inequalities in mortality over time. For example, it has been estimated that approximately half the reduction in coronary heart disease mortality from 1982 to 1993 in New Zealand was due to medical therapies, and the other half to reductions in major risk factors (Capewell et al 2000). International evidence also demonstrates that medical therapies are having an increasing role in driving down heart disease mortality rates (Hunink et al 1997). It seems plausible that (as would be predicted by the inverse care law (Hart 1971)) more advantaged socioeconomic groups would have received greater (and increasing) health benefits over time from these new and effective treatments, compared to their less advantaged counterparts. Considering cancer, it seems likely that as treatments for cancer also steadily improve, inequalities in cancer survival will also widen. Indeed, work just completed

shows marked differences in survival from certain cancers in New Zealand by ethnicity *after* adjustment for stage at presentation (Jeffreys et al in press). Analyses by socioeconomic deprivation are in progress.

It must be stressed that improving medical treatments and health services delivery need not inevitably lead to widening inequalities in health. Rather, if delivered equitably, they might provide an opportunity for *decreasing* inequalities in health. This possibility is, perhaps, the biggest challenge that this report issues to the health sector. This challenge is taken up below by Crampton, who specifically focuses on primary health care services. However, the role of hospital-based health care services also requires attention.

### Invited commentary: The role of health services

*Peter Crampton, Department of Public Health, Wellington School of Medicine and Health Sciences, University of Otago*

A concerning aspect of this report is the increasing inequality in amenable mortality over the past 20 years. These are deaths that should have been avoided through treatments provided by the health system. In the face of improving health care technologies, and knowledge of the inverse care law (a term coined by Hart in 1971), increasing inequalities should have been anticipated and preventive steps taken 20 years ago. Yet no system-wide response was adopted that might have ameliorated or prevented widening inequalities: we failed to develop social and health policies in the face of manifest need. It is only now, in the early years of the new millennium, after the signal failure to achieve 'health for all by the year 2000', that New Zealand's government is placing emphasis on reducing inequalities.

But in a modern, market-based economy, is it inevitable that the notable overall declines in amenable mortality described in this report will be associated with increasing inequality? Is increasing inequality the price of medical and public health 'progress'? Another way of voicing this same question is to ask whether the inverse care law is indeed a law, or a health system characteristic that is responsive to policy settings.

The increasing relative inequalities observed in cardiovascular disease mortality, for example, and the emerging inequalities observed in breast cancer mortality provide stark challenges. Evidence from the Netherlands suggests that health systems can contribute to overall decreases in inequalities (Mackenbach 2003). But how should we in New Zealand confront the inverse care law, the effects of which are so clearly illustrated in trends in amenable mortality? An answer to this question was offered by the World Health Assembly and UNICEF in 1975 and ratified at the International Conference on Primary Health Care in 1978 in the Alma Ata Declaration: inequalities should be confronted using a primary health care approach. In this approach, primary health care becomes the organising principle for the health system, focusing on the needs of the most disadvantaged.

There is a body of research evidence related to the health impact that can be attributed specifically to primary care. Numerous ecological (Gulliford 2002; Macinko 2003; Starfield and Shi 2002; Shi and Starfield 2001; Starfield 1991; Shi 1994; Vogel and Ackerman 1998; Roetzheim et al 2001) and mixed-level (Shi et al 2002; Shi and Starfield 2000) studies in the US and elsewhere have established associations between primary care and population health. At an individual level, research linking the defining attributes of primary care with health has also demonstrated associations between accessibility (Franks and Fiscella 1998), continuity (Mainous et al 2001; Safran et al 1998; Parchman et al 2002; Hjortdahl and Laerum 1992) and co-ordination (Safron et al 1998; Druss et al 2001) with health outcomes. Studies have also demonstrated a clear role for primary care in preventing hospitalisations (Bindman et al 1995; Oster and Bindman 2003).

Alma Ata offers more hope than piecemeal, post-hoc, issue-by-issue health system responses to inequalities because of its systems approach and its unflagging emphasis on first meeting the needs of the most disadvantaged. But in the end, it is likely that Alma Ata style primary health care alone will not be a complete answer to reducing inequalities in amenable mortality. A raft of other health system measures will be needed, aimed at ensuring health care resources are distributed according to need in every component of the health system.

In the New Zealand health care system, business as usual approaches are not satisfactory. The 2001 Primary Health Care Strategy aims to re-orient the health system around primary health care, focusing on those with the highest needs. If, in the event, the strategy does not represent the beginning of a substantial re-orientation of our health system – if it fails to modernise our health system in line with the principles of Alma Ata – then we can expect the 2014 *Decades of Disparity* report to describe further overall mortality reductions alongside further increases in inequality in amenable mortality.

## 14.6 What are the future research priorities?

While this report provides valuable and detailed information on socioeconomic mortality gradients in New Zealand over the 1980s and 1990s, it is descriptive rather than explanatory. We identify three areas for consideration as future research priorities: analytical research, modelling and policy implementation.

### 14.6.1 Analytical research

There is a relative lack of good information for New Zealand on trends in health risk factors by socioeconomic position (and ethnicity, for that matter). A comprehensive survey-based monitoring programme introduced approximately two years ago, the *New Zealand Health Monitor*, should meet this information need in the future (Ministry of Health 2002d). Retrospectively, analyses of existing data by socioeconomic position would be useful – particularly if analyses can be conducted by income, education or occupational class in addition to small-area socioeconomic deprivation.

There is a need for research that determines where, how and why socioeconomic (and ethnic) inequalities in mortality may arise due to differential access to and through health services. Such research is not well developed in New Zealand using cross-sectional studies, let alone using longitudinal data sets to allow comparisons over time.

Intervention studies on socioeconomic inequalities in health are not always possible for ethical and logistic reasons. There are, however, notable exceptions, such as the Housing and Health intervention study (work in progress, Howden-Chapman and colleagues). Further randomised intervention studies on discrete – but important and policy-relevant – mechanisms that may give rise to socioeconomic inequalities in health are warranted.

### 14.6.2 Modelling

Having determined historical trends in mortality by socioeconomic position, a next step is to predict future trends based on 'business as usual' and a range of intervention scenarios. For example, public health policy would be greatly assisted by projections of the impact of the obesity epidemic on future socioeconomic inequalities in mortality – particularly for cardiovascular disease, but also for cancer. The next step is then to determine what the most cost-effective interventions are to reduce inequalities in health in the future.

### 14.6.3 Policy

Much is known about social inequalities in health in New Zealand (Howden-Chapman and Tobias 2000; National Health Committee 1998), and knowledge is improving on how to intervene to reduce socioeconomic inequalities in health (Mackenbach et al 2002). Evaluation research and monitoring to ensure that policies that are likely to reduce inequalities in health are actually successfully implemented will become increasingly important in future.

## 14.7 What could policy makers do to reduce socioeconomic mortality gradients?

We do not provide policy advice in this monitoring report, although in our view (echoed by Richards below in her commentary) there are two main policy implications that emerge from our results.

First, the results reported here are consistent with the hypothesis that the widening of the income distribution that occurred during the 1980s and 1990s exacerbated socioeconomic inequalities in health over this period. Therefore, it seems reasonable to predict that redistributive policies aimed at narrowing the income distribution again will reduce socioeconomic inequalities in mortality.

Second, trends in socioeconomic inequalities in mortality have varied by cause of death – and are likely to continue to do so. Road traffic crash fatalities and suicides among young and middle-aged adults, as well as socioeconomic inequalities in chronic respiratory disease in older age groups, appear to be important focal points for policy based on the findings in this report. But cancer and cardiovascular disease stand out as the two main causes of death to focus on. As the chronic disease most amenable to primary prevention and treatment, cardiovascular disease group among lower socioeconomic groups emerges as a high priority if we aim to reduce inequalities in mortality. Cancer mortality also looms as a major driver of socioeconomic differences in mortality in the near future. Policies and programmes designed to reduce overall cancer incidence and mortality (eg, primary prevention, screening, access to new treatment modalities) need to be responsive to the concerns and preferences of low-income people, as well as to Māori and Pacific peoples, in order to avoid unintentionally exacerbating socioeconomic inequalities in health.

## Invited commentary: How should policy makers and their advisors respond?

*Dr Ruth Richards, Ministry of Health, New Zealand*

Policy must be based on evidence and translated into action. This report identifies income (and to a lesser extent education and occupation) as a place to look for policy options to reduce inequalities in health. The Ministry of Health's Reducing Inequalities Intervention Framework identifies points of intervention that can be used to reduce inequalities, and this research highlights points within that framework at which to act.

From a policy perspective, health inequalities by income can and should be considered both within and outside the health sector. Within the health sector, the aim is to identify policy options and actions that could mitigate the impact of low income on health, and interventions to maintain income levels for those who develop chronic disease or disability.

The research points to avoidable and amenable mortality as one place to start. Both demonstrate strong gradients by income that also increase over time – despite falling rates within each income group. Avoidable mortality points to population health policies and interventions (upstream influences), and amenable mortality points to systemic and individual policies and actions (downstream influences) that need to be considered within the health system.

The major causes of death contributing to the demonstrated income inequalities also suggest places to start, with cardiovascular disease and cancer standing out. Other causes of death, such as subsets of the cancer group, are also worth investigating. Cancer overtakes cardiovascular disease in women as the major contributor to the income gradient in mortality by the end of the research period. Policy effort therefore needs to be maintained in relation to cardiovascular disease, but needs to be increased for cancer – especially in relation to the specific cancers described in the report. Major progress has been made in reduction of cardiovascular disease mortality, but differentials by income remain. It is important to learn from this experience and take it into account when developing the policy response to cancer.

What is it in the health sector that creates and maintains inequalities in health? This research gives an indication that it may be the access to, and pathways through, health care that systematically discriminates against people with low incomes and therefore denies them the same opportunity to health as those with higher incomes. Institutional theory may be usefully applied to the health sector when considering what options exist to reduce the inequalities demonstrated by income (and other measures of socioeconomic position).

Although the research focuses on inequalities by income, education and occupational class are also considered, if only briefly. These are all related – education and occupation contributing to income potential. The fact that some of the major effects of socioeconomic differentials are seen in the
25–44 years age group indicates that the relationship to education may be particularly salient from a policy perspective. What should the policy response in the education sector (and other social policy areas) be? To a degree this is up to each sector, but it also supports the need for joint policy work on health inequalities with other sectors.

Therefore, the two major policy responses to this research are to:

- consider income as an important influence on inequalities in health in all policy work within the health sector, focusing on the age group and the conditions that contribute most to the inequalities (young adults and CVD and cancer)
- work with other sectors in lessening the burden of the income differential on health.

Current work across government agencies includes the joint position adopted by Cabinet in July 2004, *Reducing Inequalities: The next steps*. The key goal of reducing inequalities in that paper reflects fundamental principles relating to social justice – a desire to *reduce disadvantage* and *promote equality of opportunity* in order to achieve a similar distribution of outcomes between groups, and a more equitable distribution of overall outcomes within society.

Reducing Inequalities is a whole of government policy encompassing both social and economic initiatives. It represents government's key initiatives that aim to tackle disadvantage, reduce inequalities and improve outcomes for all. It includes major initiatives across a wide range of sectors that are encapsulated in such documents as the Primary Healthcare Strategy, the Adult Literacy Strategy, the Crime Reduction Strategy, and many aspects of the Employment Strategy. Many of these initiatives are outlined annually by thirteen of the larger departments in their annual reports.

Within the Ministry of Health, work continues to promote the equity tools that have been developed – the Reducing Inequalities Intervention Framework and the Health Equity Assessment Tool. Workshops have been held with District Health Boards, and DHBs include equity in their annual planning and reporting processes.

The Cancer Control Strategy includes the whole spectrum of cancer control from prevention to palliative care. An implementation plan is due in December 2004. This strategy was developed taking equity into consideration, and this research will help in the implementation and strengthening of this dimension of the Strategy. Further research on the barriers to accessing cancer services for Māori is also currently being undertaken.

# Appendix: Additional Results

**Table 46:** All-cause mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| All-cause: males | | | | | | | |
| 25–77 years | 1981–84 | 1248 | (1214–1281) | 1010 | (974–1046) | 872 | (837–906) |
| | 1986–89 | 1139 | (1110–1168) | 950 | (923–978) | 766 | (733–799) |
| | 1991–94 | 1025 | (1000–1050) | 818 | (790–845) | 634 | (606–661) |
| | 1996–99 | 910 | (887–934) | 711 | (686–736) | 528 | (505–551) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 204 | (181–227) | 167 | (148–187) | 151 | (132–171) |
| | 1986–89 | 192 | (171–212) | 168 | (151–186) | 144 | (127–161) |
| | 1991–94 | 219 | (197–240) | 169 | (150–188) | 123 | (109–137) |
| | 1996–99 | 208 | (186–231) | 147 | (129–165) | 121 | (108–134) |
| | P (trend) | 0.53 | – | 0.25 | – | 0.07 | – |
| 45–59 years | 1981–84 | 1033 | (956–1110) | 827 | (776–879) | 700 | (658–743) |
| | 1986–89 | 895 | (829–961) | 748 | (704–792) | 611 | (573–648) |
| | 1991–94 | 822 | (768–875) | 617 | (574–660) | 457 | (427–487) |
| | 1996–99 | 732 | (684–780) | 531 | (494–569) | 355 | (332–377) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 4238 | (4121–4354) | 3436 | (3281–3591) | 2964 | (2813–3115) |
| | 1986–89 | 3913 | (3813–4013) | 3241 | (3128–3355) | 2582 | (2437–2727) |
| | 1991–94 | 3382 | (3301–3463) | 2759 | (2645–2873) | 2186 | (2061–2311) |
| | 1996–99 | 2964 | (2888–3040) | 2408 | (2307–2509) | 1805 | (1701–1909) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| All-cause: females | | | | | | | |
| 25–77 years | 1981–84 | 700 | (678–722) | 611 | (582–641) | 549 | (518–581) |
| | 1986–89 | 671 | (652–691) | 581 | (559–603) | 490 | (459–520) |
| | 1991–94 | 601 | (584–617) | 514 | (491–536) | 414 | (391–438) |
| | 1996–99 | 545 | (530–560) | 440 | (421–459) | 364 | (341–387) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 102 | (87.9–116) | 104 | (89.6–119) | 97.0 | (80.8–113) |
| | 1986–89 | 97.9 | (85.7–110) | 88.1 | (76.2–100) | 77.2 | (64.1–90.3) |
| | 1991–94 | 97.3 | (85.7–109) | 79.0 | (67.3–90.8) | 67.9 | (57.6–78.3) |
| | 1996–99 | 100 | (89.2–112) | 72.2 | (61.6–82.9) | 59.6 | (50.6–68.6) |
| | P (trend) | 0.83 | – | < .01 | – | < .01 | – |
| 45–59 years | 1981–84 | 599 | (548–649) | 500 | (457–542) | 399 | (366–432) |
| | 1986–89 | 568 | (523–614) | 465 | (430–500) | 318 | (290–345) |
| | 1991–94 | 516 | (480–553) | 420 | (385–454) | 292 | (267–316) |
| | 1996–99 | 460 | (426–493) | 369 | (339–400) | 257 | (237–276) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 2219 | (2147–2291) | 1927 | (1809–2046) | 1779 | (1648–1909) |
| | 1986–89 | 2134 | (2069–2198) | 1868 | (1782–1955) | 1649 | (1521–1776) |
| | 1991–94 | 1878 | (1824–1933) | 1640 | (1552–1727) | 1364 | (1265–1464) |
| | 1996–99 | 1686 | (1635–1736) | 1382 | (1309–1455) | 1198 | (1100–1295) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |

**Table 47:** All-cause mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| All–cause: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.43 | (1.36–1.50) | 1.16 | (1.10–1.22) | 376 | (328–424) | 139 | (89–189) |
| | 1986–89 | 1.49 | (1.41–1.56) | 1.24 | (1.18–1.31) | 373 | (329–416) | 184 | (141–227) |
| | 1991–94 | 1.62 | (1.54–1.70) | 1.29 | (1.22–1.36) | 391 | (354–428) | 184 | (145–223) |
| | 1996–99 | 1.72 | (1.64–1.81) | 1.35 | (1.27–1.43) | 383 | (350–415) | 183 | (149–217) |
| 25–44 years | 1981–84 | 1.35 | (1.14–1.60) | 1.10 | (0.93–1.31) | 53 | (23–83) | 16 | (-11–43) |
| | 1986–89 | 1.33 | (1.13–1.56) | 1.17 | (1.00–1.37) | 48 | (21–74) | 24 | (-0–49) |
| | 1991–94 | 1.78 | (1.53–2.07) | 1.38 | (1.18–1.61) | 96 | (70–121) | 46 | (23–69) |
| | 1996–99 | 1.72 | (1.47–2.00) | 1.21 | (1.03–1.42) | 87 | (61–113) | 25 | (3–48) |
| 45–59 years | 1981–84 | 1.48 | (1.34–1.62) | 1.18 | (1.08–1.29) | 333 | (246–421) | 127 | (60–195) |
| | 1986–89 | 1.46 | (1.33–1.61) | 1.22 | (1.12–1.33) | 284 | (208–360) | 137 | (79–195) |
| | 1991–94 | 1.80 | (1.64–1.97) | 1.35 | (1.23–1.49) | 364 | (303–426) | 160 | (108–212) |
| | 1996–99 | 2.07 | (1.88–2.26) | 1.50 | (1.36–1.65) | 378 | (325–431) | 177 | (133–221) |
| 60–77 years | 1981–84 | 1.43 | (1.35–1.52) | 1.16 | (1.08–1.24) | 1274 | (1083–1465) | 472 | (256–688) |
| | 1986–89 | 1.52 | (1.42–1.61) | 1.26 | (1.18–1.34) | 1331 | (1155–1508) | 659 | (476–843) |
| | 1991–94 | 1.55 | (1.45–1.65) | 1.26 | (1.18–1.35) | 1196 | (1047–1344) | 573 | (404–742) |
| | 1996–99 | 1.64 | (1.54–1.75) | 1.33 | (1.24–1.43) | 1159 | (1030–1288) | 603 | (458–748) |
| All–cause: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.27 | (1.19–1.36) | 1.11 | (1.03–1.20) | 151 | (112–189) | 62 | (19–105) |
| | 1986–89 | 1.37 | (1.28–1.47) | 1.19 | (1.10–1.28) | 182 | (146–218) | 91 | (54–129) |
| | 1991–94 | 1.45 | (1.36–1.54) | 1.24 | (1.15–1.33) | 186 | (157–215) | 99 | (67–132) |
| | 1996–99 | 1.50 | (1.40–1.60) | 1.21 | (1.12–1.30) | 181 | (154–209) | 76 | (46–106) |
| 25–44 years | 1981–84 | 1.05 | (0.85–1.30) | 1.07 | (0.86–1.33) | 5 | (-16–26) | 7 | (-15–29) |
| | 1986–89 | 1.27 | (1.03–1.57) | 1.14 | (0.92–1.42) | 21 | (3–39) | 11 | (-7–29) |
| | 1991–94 | 1.43 | (1.18–1.74) | 1.16 | (0.94–1.44) | 29 | (14–45) | 11 | (-5–27) |
| | 1996–99 | 1.69 | (1.40–2.04) | 1.21 | (0.98–1.50) | 41 | (27–55) | 13 | (-1–27) |
| 45–59 years | 1981–84 | 1.50 | (1.33–1.69) | 1.25 | (1.11–1.41) | 200 | (140–260) | 101 | (47–155) |
| | 1986–89 | 1.79 | (1.59–2.01) | 1.46 | (1.31–1.64) | 251 | (197–304) | 147 | (103–192) |
| | 1991–94 | 1.77 | (1.59–1.98) | 1.44 | (1.28–1.62) | 225 | (181–269) | 128 | (86–171) |
| | 1996–99 | 1.79 | (1.61–1.99) | 1.44 | (1.29–1.61) | 203 | (164–242) | 113 | (77–149) |
| 60–77 years | 1981–84 | 1.25 | (1.15–1.35) | 1.08 | (0.98–1.19) | 440 | (291–589) | 149 | (-27–325) |
| | 1986–89 | 1.29 | (1.19–1.41) | 1.13 | (1.04–1.24) | 485 | (342–628) | 220 | (66–374) |
| | 1991–94 | 1.38 | (1.27–1.49) | 1.20 | (1.10–1.32) | 514 | (401–628) | 275 | (142–408) |
| | 1996–99 | 1.41 | (1.29–1.53) | 1.15 | (1.05–1.27) | 488 | (378–598) | 185 | (63–306) |

**Table 48:** Avoidable mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Avoidable mortality: males | | | | | | | |
| 25–77 years | 1981–84 | 1032 | (1002–1062) | 836 | (803–869) | 719 | (688–751) |
| | 1986–89 | 928 | (902–954) | 772 | (747–797) | 597 | (568–625) |
| | 1991–94 | 812 | (790–833) | 641 | (617–666) | 481 | (458–505) |
| | 1996–99 | 707 | (686–727) | 541 | (519–563) | 390 | (370–411) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 152 | (132–172) | 125 | (108–142) | 108 | (92.2–124) |
| | 1986–89 | 143 | (125–160) | 131 | (115–147) | 105 | (90.3–119) |
| | 1991–94 | 170 | (151–190) | 130 | (113–147) | 99.8 | (87.3–112) |
| | 1996–99 | 159 | (140–179) | 118 | (102–135) | 88.4 | (77.2–99.7) |
| | P (trend) | 0.45 | – | 0.45 | – | < .01 | – |
| 45–59 years | 1981–84 | 843 | (774–912) | 702 | (654–750) | 582 | (543–620) |
| | 1986–89 | 710 | (651–768) | 612 | (572–652) | 506 | (472–540) |
| | 1991–94 | 644 | (596–692) | 490 | (452–528) | 363 | (336–390) |
| | 1996–99 | 572 | (529–614) | 414 | (381–448) | 261 | (242–280) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 3564 | (3457–3670) | 2856 | (2716–2997) | 2485 | (2346–2624) |
| | 1986–89 | 3249 | (3157–3340) | 2643 | (2541–2745) | 1994 | (1867–2120) |
| | 1991–94 | 2693 | (2621–2765) | 2162 | (2062–2262) | 1625 | (1519–1730) |
| | 1996–99 | 2303 | (2236–2370) | 1801 | (1714–1888) | 1340 | (1249–1430) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| Avoidable mortality: females | | | | | | | |
| 25–77 years | 1981–84 | 572 | (553–592) | 501 | (475–528) | 459 | (430–489) |
| | 1986–89 | 547 | (529–564) | 467 | (447–487) | 387 | (361–414) |
| | 1991–94 | 476 | (461–490) | 412 | (392–432) | 333 | (312–355) |
| | 1996–99 | 423 | (410–437) | 337 | (320–353) | 271 | (252–291) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 81.0 | (68.6–93.4) | 77.3 | (65.2–89.4) | 75.7 | (61.7–89.7) |
| | 1986–89 | 72.5 | (62.1–83.0) | 70.7 | (60.3–81.1) | 61.7 | (50.2–73.2) |
| | 1991–94 | 73.7 | (63.6–83.8) | 59.0 | (48.6–69.3) | 51.5 | (42.9–60.1) |
| | 1996–99 | 79.3 | (69.2–89.3) | 50.4 | (41.4–59.4) | 44.3 | (36.4–52.1) |
| | P (trend) | 0.97 | – | < .01 | – | < .01 | – |
| 45–59 years | 1981–84 | 480 | (435–525) | 400 | (362–438) | 327 | (297–358) |
| | 1986–89 | 468 | (427–509) | 372 | (342–403) | 253 | (228–278) |
| | 1991–94 | 402 | (370–434) | 321 | (290–351) | 229 | (207–251) |
| | 1996–99 | 353 | (324–382) | 295 | (268–322) | 198 | (181–216) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 1829 | (1764–1894) | 1611 | (1503–1719) | 1507 | (1385–1628) |
| | 1986–89 | 1750 | (1691–1808) | 1503 | (1426–1581) | 1301 | (1191–1410) |
| | 1991–94 | 1503 | (1455–1552) | 1343 | (1263–1423) | 1110 | (1019–1201) |
| | 1996–99 | 1310 | (1265–1355) | 1057 | (993–1120) | 886 | (803–970) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |

**Table 49:** Avoidable mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Avoidable mortality: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.44 | (1.36–1.51) | 1.16 | (1.10–1.23) | 313 | (270–357) | 117 | (71–162) |
| | 1986–89 | 1.55 | (1.47–1.64) | 1.29 | (1.22–1.37) | 331 | (293–370) | 175 | (137–213) |
| | 1991–94 | 1.69 | (1.59–1.78) | 1.33 | (1.25–1.42) | 330 | (298–362) | 160 | (126–194) |
| | 1996–99 | 1.81 | (1.71–1.92) | 1.39 | (1.30–1.48) | 316 | (288–345) | 150 | (121–180) |
| 25–44 years | 1981–84 | 1.41 | (1.16–1.72) | 1.16 | (0.95–1.41) | 44 | (19–70) | 17 | (-6–40) |
| | 1986–89 | 1.36 | (1.13–1.64) | 1.25 | (1.04–1.50) | 38 | (15–61) | 26 | (5–48) |
| | 1991–94 | 1.71 | (1.44–2.02) | 1.30 | (1.09–1.56) | 71 | (48–94) | 30 | (9–51) |
| | 1996–99 | 1.80 | (1.51–2.15) | 1.34 | (1.11–1.61) | 71 | (48–94) | 30 | (10–50) |
| 45–59 years | 1981–84 | 1.45 | (1.30–1.61) | 1.21 | (1.10–1.33) | 261 | (182–340) | 120 | (59–181) |
| | 1986–89 | 1.40 | (1.26–1.56) | 1.21 | (1.10–1.33) | 204 | (136–272) | 106 | (54–159) |
| | 1991–94 | 1.78 | (1.60–1.97) | 1.35 | (1.21–1.51) | 281 | (226–336) | 127 | (81–174) |
| | 1996–99 | 2.19 | (1.97–2.43) | 1.59 | (1.42–1.77) | 311 | (264–357) | 153 | (115–192) |
| 60–77 years | 1981–84 | 1.43 | (1.35–1.53) | 1.15 | (1.07–1.24) | 1079 | (904–1254) | 372 | (174–569) |
| | 1986–89 | 1.63 | (1.52–1.75) | 1.33 | (1.23–1.43) | 1255 | (1099–1411) | 649 | (486–811) |
| | 1991–94 | 1.66 | (1.54–1.78) | 1.33 | (1.23–1.44) | 1068 | (940–1196) | 537 | (392–683) |
| | 1996–99 | 1.72 | (1.60–1.85) | 1.34 | (1.24–1.46) | 964 | (851–1076) | 461 | (336–587) |
| Avoidable mortality: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.25 | (1.16–1.34) | 1.09 | (1.00–1.19) | 113 | (78–148) | 42 | (2–82) |
| | 1986–89 | 1.41 | (1.31–1.52) | 1.21 | (1.11–1.31) | 159 | (128–191) | 80 | (47–112) |
| | 1991–94 | 1.43 | (1.33–1.53) | 1.24 | (1.14–1.34) | 143 | (117–169) | 79 | (49–108) |
| | 1996–99 | 1.56 | (1.44–1.69) | 1.24 | (1.14–1.35) | 152 | (128–176) | 65 | (40–91) |
| 25–44 years | 1981–84 | 1.07 | (0.84–1.36) | 1.02 | (0.80–1.30) | 5 | (-13–24) | 2 | (-17–20) |
| | 1986–89 | 1.17 | (0.93–1.49) | 1.14 | (0.90–1.45) | 11 | (-5–26) | 9 | (-7–25) |
| | 1991–94 | 1.43 | (1.15–1.78) | 1.15 | (0.90–1.46) | 22 | (9–36) | 8 | (-6–21) |
| | 1996–99 | 1.79 | (1.44–2.22) | 1.14 | (0.89–1.46) | 35 | (22–48) | 6 | (-6–18) |
| 45–59 years | 1981–84 | 1.47 | (1.29–1.67) | 1.22 | (1.07–1.40) | 153 | (98–207) | 73 | (24–121) |
| | 1986–89 | 1.85 | (1.62–2.11) | 1.47 | (1.29–1.67) | 215 | (166–263) | 119 | (80–159) |
| | 1991–94 | 1.76 | (1.55–1.99) | 1.40 | (1.22–1.60) | 173 | (134–212) | 92 | (54–129) |
| | 1996–99 | 1.78 | (1.58–2.01) | 1.49 | (1.31–1.69) | 155 | (121–189) | 97 | (65–129) |
| 60–77 years | 1981–84 | 1.21 | (1.11–1.33) | 1.07 | (0.96–1.19) | 323 | (185–461) | 104 | (-58–267) |
| | 1986–89 | 1.35 | (1.23–1.47) | 1.16 | (1.05–1.28) | 449 | (325–574) | 203 | (68–337) |
| | 1991–94 | 1.35 | (1.24–1.48) | 1.21 | (1.09–1.34) | 393 | (291–496) | 233 | (112–353) |
| | 1996–99 | 1.48 | (1.34–1.63) | 1.19 | (1.07–1.33) | 424 | (329–518) | 170 | (65–275) |

**Table 50:** Non-avoidable mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Non-avoidable mortality: males | | | | | | | |
| 25–77 years | 1981–84 | 216 | (201–230) | 174 | (159–190) | 152 | (138–167) |
| | 1986–89 | 211 | (198–224) | 178 | (166–190) | 169 | (153–185) |
| | 1991–94 | 213 | (202–225) | 176 | (164–189) | 152 | (138–167) |
| | 1996–99 | 204 | (193–215) | 170 | (158–182) | 138 | (126–149) |
| | P (trend) | 0.19 | – | 0.38 | – | 0.26 | – |
| 25–44 years | 1981–84 | 51.7 | (40.2–63.3) | 42.1 | (32.1–52.1) | 43.3 | (32.5–54.1) |
| | 1986–89 | 49.3 | (39.1–59.5) | 37.5 | (29.5–45.5) | 39.4 | (30.4–48.5) |
| | 1991–94 | 48.2 | (38.5–57.9) | 38.9 | (30.5–47.3) | 22.9 | (17.3–28.5) |
| | 1996–99 | 48.8 | (38.2–59.4) | 28.5 | (21.2–35.8) | 32.9 | (26.2–39.7) |
| | P (trend) | 0.19 | – | 0.07 | – | 0.50 | – |
| 45–59 years | 1981–84 | 191 | (157–224) | 125 | (105–146) | 118 | (99.8–137) |
| | 1986–89 | 185 | (155–215) | 136 | (117–155) | 105 | (89.0–121) |
| | 1991–94 | 178 | (153–203) | 127 | (108–146) | 94.5 | (80.6–108) |
| | 1996–99 | 161 | (138–183) | 117 | (99.3–135) | 93.6 | (81.7–106) |
| | P (trend) | 0.02 | – | 0.38 | – | 0.07 | – |
| 60–77 years | 1981–84 | 674 | (627–721) | 580 | (515–644) | 479 | (419–539) |
| | 1986–89 | 664 | (623–706) | 599 | (550–648) | 588 | (518–659) |
| | 1991–94 | 689 | (652–726) | 597 | (543–651) | 561 | (495–628) |
| | 1996–99 | 661 | (625–697) | 607 | (557–658) | 465 | (413–517) |
| | P (trend) | 0.79 | – | 0.07 | – | 0.79 | – |
| Non-avoidable mortality: females | | | | | | | |
| 25–77 years | 1981–84 | 128 | (118–137) | 110 | (97.5–122) | 90.0 | (78.0–102) |
| | 1986–89 | 124 | (116–133) | 114 | (104–124) | 102 | (86.8–118) |
| | 1991–94 | 125 | (117–132) | 102 | (92.1–111) | 81.2 | (71.0–91.5) |
| | 1996–99 | 122 | (115–129) | 103 | (93.9–112) | 92.5 | (80.8–104) |
| | P (trend) | 0.07 | – | 0.26 | – | 0.79 | – |
| 25–44 years | 1981–84 | 20.8 | (14.5–27.1) | 26.8 | (18.6–35.0) | 21.3 | (13.1–29.4) |
| | 1986–89 | 25.4 | (19.0–31.7) | 17.4 | (11.7–23.2) | 15.4 | (9.2–21.7) |
| | 1991–94 | 23.6 | (17.8–29.4) | 20.1 | (14.5–25.6) | 16.4 | (10.7–22.2) |
| | 1996–99 | 21.2 | (16.1–26.3) | 21.8 | (16.0–27.7) | 15.3 | (10.8–19.8) |
| | P (trend) | 0.86 | – | 0.79 | – | 0.26 | – |
| 45–59 years | 1981–84 | 119 | (95.9–142) | 100 | (81.3–119) | 71.6 | (58.2–84.9) |
| | 1986–89 | 100 | (81.0–120) | 92.6 | (76.7–109) | 64.6 | (52.8–76.5) |
| | 1991–94 | 114 | (97.0–132) | 99.1 | (82.5–116) | 62.6 | (51.2–74.0) |
| | 1996–99 | 106 | (90.0–123) | 74.4 | (60.8–88.0) | 58.6 | (49.3–67.8) |
| | P (trend) | 0.71 | – | 0.19 | – | 0.02 | – |
| 60–77 years | 1981–84 | 390 | (359–420) | 317 | (269–365) | 272 | (224–319) |
| | 1986–89 | 384 | (357–411) | 365 | (327–403) | 348 | (282–414) |
| | 1991–94 | 375 | (351–399) | 297 | (261–333) | 254 | (213–296) |
| | 1996–99 | 376 | (351–400) | 326 | (290–361) | 311 | (261–361) |
| | P (trend) | 0.07 | – | 0.71 | – | 0.86 | – |

**Table 51:** Non-avoidable mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Non-avoidable mortality: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.42 | (1.26–1.59) | 1.14 | (1.01–1.30) | 63 | (43–84) | 22 | (1–43) |
| | 1986–89 | 1.25 | (1.11–1.39) | 1.05 | (0.94–1.18) | 42 | (21–62) | 9 | (-11–29) |
| | 1991–94 | 1.40 | (1.26–1.56) | 1.16 | (1.03–1.31) | 61 | (43–80) | 24 | (5–44) |
| | 1996–99 | 1.48 | (1.34–1.64) | 1.24 | (1.11–1.38) | 66 | (50–82) | 33 | (16–50) |
| 25–44 years | 1981–84 | 1.19 | (0.86–1.67) | 0.97 | (0.69–1.37) | 8 | (-7–24) | -1 | (-16–14) |
| | 1986–89 | 1.25 | (0.92–1.70) | 0.95 | (0.70–1.30) | 10 | (-4–24) | -2 | (-14–10) |
| | 1991–94 | 2.10 | (1.53–2.88) | 1.70 | (1.23–2.35) | 25 | (14–37) | 16 | (6–26) |
| | 1996–99 | 1.48 | (1.10–2.00) | 0.87 | (0.62–1.20) | 16 | (3–28) | -4 | (-14–6) |
| 45–59 years | 1981–84 | 1.61 | (1.27–2.04) | 1.06 | (0.85–1.33) | 72 | (34–111) | 7 | (-20–35) |
| | 1986–89 | 1.76 | (1.41–2.20) | 1.30 | (1.06–1.59) | 80 | (46–114) | 31 | (6–56) |
| | 1991–94 | 1.88 | (1.54–2.30) | 1.34 | (1.09–1.66) | 83 | (55–112) | 33 | (9–56) |
| | 1996–99 | 1.72 | (1.42–2.07) | 1.25 | (1.03–1.52) | 67 | (42–92) | 23 | (2–45) |
| 60–77 years | 1981–84 | 1.41 | (1.22–1.62) | 1.21 | (1.02–1.43) | 195 | (119–271) | 101 | (12–189) |
| | 1986–89 | 1.13 | (0.99–1.29) | 1.02 | (0.88–1.18) | 76 | (-6–158) | 11 | (-75–97) |
| | 1991–94 | 1.23 | (1.08–1.40) | 1.06 | (0.92–1.23) | 127 | (52–203) | 36 | (-50–121) |
| | 1996–99 | 1.42 | (1.25–1.61) | 1.30 | (1.13–1.50) | 196 | (133–259) | 142 | (69–215) |
| Non-avoidable mortality: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.42 | (1.22–1.65) | 1.22 | (1.03–1.46) | 38 | (23–53) | 20 | (3–37) |
| | 1986–89 | 1.22 | (1.03–1.44) | 1.12 | (0.94–1.33) | 22 | (5–40) | 12 | (-7–30) |
| | 1991–94 | 1.54 | (1.34–1.77) | 1.25 | (1.07–1.47) | 44 | (31–56) | 21 | (6–35) |
| | 1996–99 | 1.32 | (1.14–1.51) | 1.11 | (0.95–1.30) | 29 | (16–43) | 11 | (-4–26) |
| 25–44 years | 1981–84 | 0.98 | (0.60–1.60) | 1.26 | (0.77–2.06) | -1 | (-11–10) | 6 | (-6–17) |
| | 1986–89 | 1.64 | (1.02–2.64) | 1.13 | (0.67–1.90) | 10 | (1–19) | 2 | (-7–11) |
| | 1991–94 | 1.44 | (0.94–2.20) | 1.22 | (0.78–1.91) | 7 | (-1–15) | 4 | (-4–12) |
| | 1996–99 | 1.39 | (0.95–2.03) | 1.43 | (0.96–2.12) | 6 | (-1–13) | 7 | (-1–14) |
| 45–59 years | 1981–84 | 1.66 | (1.27–2.18) | 1.40 | (1.07–1.82) | 47 | (21–74) | 29 | (6–52) |
| | 1986–89 | 1.55 | (1.19–2.03) | 1.43 | (1.11–1.84) | 36 | (13–59) | 28 | (8–48) |
| | 1991–94 | 1.83 | (1.44–2.32) | 1.58 | (1.24–2.03) | 52 | (31–73) | 37 | (16–57) |
| | 1996–99 | 1.82 | (1.46–2.27) | 1.27 | (1.00–1.62) | 48 | (29–67) | 16 | (-1–32) |
| 60–77 years | 1981–84 | 1.43 | (1.18–1.74) | 1.16 | (0.92–1.47) | 118 | (62–174) | 45 | (-23–112) |
| | 1986–89 | 1.10 | (0.90–1.35) | 1.05 | (0.85–1.30) | 36 | (-35–107) | 17 | (-59–93) |
| | 1991–94 | 1.47 | (1.24–1.76) | 1.17 | (0.95–1.43) | 121 | (73–169) | 43 | (-13–98) |
| | 1996–99 | 1.21 | (1.01–1.43) | 1.05 | (0.86–1.27) | 64 | (9–120) | 14 | (-47–76) |

**Table 52:** Amenable mortality rates per 100,000 by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Amenable mortality: males | | | | | | | |
| 25–77 years | 1981–84 | 399 | (381–417) | 320 | (300–340) | 270 | (251–290) |
| | 1986–89 | 347 | (332–362) | 295 | (280–311) | 232 | (214–250) |
| | 1991–94 | 295 | (283–307) | 229 | (215–244) | 178 | (163–193) |
| | 1996–99 | 256 | (244–267) | 200 | (188–213) | 136 | (124–149) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 26.2 | (18.7–33.7) | 26.3 | (19.3–33.3) | 22.8 | (15.8–29.7) |
| | 1986–89 | 22.2 | (15.9–28.5) | 24.0 | (17.7–30.4) | 16.4 | (10.7–22.1) |
| | 1991–94 | 20.8 | (15.0–26.5) | 13.1 | (8.8–17.4) | 13.7 | (9.1–18.3) |
| | 1996–99 | 17.0 | (11.9–22.1) | 14.4 | (9.7–19.2) | 12.2 | (8.5–16.0) |
| | P (trend) | < .01 | – | 0.06 | – | 0.06 | – |
| 45–59 years | 1981–84 | 299 | (259–340) | 276 | (247–306) | 219 | (197–241) |
| | 1986–89 | 247 | (213–281) | 222 | (199–246) | 196 | (175–218) |
| | 1991–94 | 234 | (206–263) | 169 | (147–192) | 128 | (112–145) |
| | 1996–99 | 202 | (177–227) | 143 | (124–163) | 87.8 | (76.6–99.0) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 1495 | (1426–1564) | 1141 | (1052–1230) | 979 | (891–1067) |
| | 1986–89 | 1319 | (1261–1377) | 1094 | (1028–1160) | 838 | (755–921) |
| | 1991–94 | 1085 | (1040–1131) | 867 | (803–931) | 668 | (599–737) |
| | 1996–99 | 945 | (902–987) | 757 | (701–813) | 520 | (462–578) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| Amenable mortality: females | | | | | | | |
| 25–77 years | 1981–84 | 252 | (239–264) | 222 | (205–240) | 210 | (191–230) |
| | 1986–89 | 243 | (231–254) | 211 | (198–224) | 180 | (163–198) |
| | 1991–94 | 211 | (201–220) | 185 | (172–198) | 150 | (136–164) |
| | 1996–99 | 187 | (178–196) | 157 | (146–168) | 124 | (111–138) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 28.0 | (20.8–35.3) | 32.7 | (25.1–40.3) | 27.8 | (19.9–35.7) |
| | 1986–89 | 26.0 | (19.9–32.1) | 27.1 | (21.2–32.9) | 19.8 | (13.6–26.0) |
| | 1991–94 | 18.1 | (13.5–22.8) | 16.2 | (11.0–21.4) | 15.1 | (10.8–19.5) |
| | 1996–99 | 19.3 | (14.9–23.8) | 19.0 | (13.8–24.2) | 15.6 | (11.1–20.1) |
| | P (trend) | 0.15 | – | 0.15 | – | 0.06 | – |
| 45–59 years | 1981–84 | 205 | (175–234) | 178 | (153–203) | 155 | (136–174) |
| | 1986–89 | 220 | (192–248) | 171 | (151–192) | 124 | (107–140) |
| | 1991–94 | 173 | (152–194) | 167 | (145–189) | 110 | (95.8–125) |
| | 1996–99 | 172 | (151–192) | 140 | (121–158) | 98.7 | (86.3–111) |
| | P (trend) | 0.15 | – | 0.06 | – | < .01 | – |
| 60–77 years | 1981–84 | 829 | (785–873) | 717 | (646–788) | 701 | (619–783) |
| | 1986–89 | 778 | (740–817) | 687 | (634–739) | 621 | (546–696) |
| | 1991–94 | 705 | (672–738) | 602 | (550–655) | 511 | (451–570) |
| | 1996–99 | 599 | (569–630) | 500 | (456–544) | 408 | (350–465) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |

**Table 53:** Amenable mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Amenable mortality: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.48 | (1.36–1.61) | 1.19 | (1.08–1.30) | 129 | (102–155) | 50 | (22–78) |
| | 1986–89 | 1.50 | (1.37–1.64) | 1.27 | (1.16–1.40) | 115 | (92–139) | 63 | (40–87) |
| | 1991–94 | 1.66 | (1.51–1.82) | 1.29 | (1.16–1.43) | 117 | (98–136) | 51 | (30–72) |
| | 1996–99 | 1.88 | (1.70–2.08) | 1.47 | (1.32–1.65) | 119 | (103–136) | 64 | (46–82) |
| 25–44 years | 1981–84 | 1.15 | (0.76–1.75) | 1.16 | (0.77–1.73) | 3 | (-7–14) | 4 | (-6–13) |
| | 1986–89 | 1.35 | (0.86–2.12) | 1.47 | (0.95–2.26) | 6 | (-3–14) | 8 | (-1–16) |
| | 1991–94 | 1.52 | (0.98–2.34) | 0.96 | (0.60–1.53) | 7 | (-0–14) | -1 | (-7–6) |
| | 1996–99 | 1.39 | (0.90–2.14) | 1.18 | (0.75–1.85) | 5 | (-2–11) | 2 | (-4–8) |
| 45–59 years | 1981–84 | 1.36 | (1.15–1.62) | 1.26 | (1.09–1.46) | 80 | (34–126) | 57 | (20–94) |
| | 1986–89 | 1.26 | (1.05–1.50) | 1.13 | (0.97–1.32) | 51 | (10–91) | 26 | (-6–58) |
| | 1991–94 | 1.83 | (1.53–2.18) | 1.32 | (1.10–1.59) | 106 | (73–139) | 41 | (14–69) |
| | 1996–99 | 2.30 | (1.93–2.75) | 1.63 | (1.35–1.97) | 114 | (87–142) | 56 | (33–78) |
| 60–77 years | 1981–84 | 1.53 | (1.38–1.69) | 1.17 | (1.03–1.31) | 516 | (405–628) | 162 | (37–288) |
| | 1986–89 | 1.57 | (1.41–1.75) | 1.31 | (1.16–1.47) | 481 | (380–583) | 256 | (150–362) |
| | 1991–94 | 1.62 | (1.45–1.82) | 1.30 | (1.14–1.47) | 417 | (335–500) | 199 | (105–293) |
| | 1996–99 | 1.82 | (1.61–2.05) | 1.46 | (1.27–1.66) | 425 | (353–497) | 237 | (156–318) |
| Amenable mortality: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.20 | (1.08–1.33) | 1.06 | (0.93–1.19) | 41 | (18–64) | 12 | (-15–38) |
| | 1986–89 | 1.35 | (1.21–1.50) | 1.17 | (1.04–1.31) | 62 | (41–84) | 30 | (8–53) |
| | 1991–94 | 1.40 | (1.27–1.56) | 1.23 | (1.10–1.39) | 61 | (44–78) | 35 | (16–54) |
| | 1996–99 | 1.51 | (1.34–1.70) | 1.26 | (1.11–1.44) | 63 | (47–79) | 33 | (15–50) |
| 25–44 years | 1981–84 | 1.01 | (0.69–1.48) | 1.18 | (0.81–1.70) | 0 | (-11–11) | 5 | (-6–16) |
| | 1986–89 | 1.31 | (0.89–1.94) | 1.37 | (0.93–2.00) | 6 | (-3–15) | 7 | (-1–16) |
| | 1991–94 | 1.20 | (0.81–1.76) | 1.07 | (0.70–1.65) | 3 | (-3–9) | 1 | (-6–8) |
| | 1996–99 | 1.24 | (0.86–1.80) | 1.22 | (0.82–1.81) | 4 | (-3–10) | 3 | (-3–10) |
| 45–59 years | 1981–84 | 1.32 | (1.10–1.59) | 1.15 | (0.95–1.38) | 50 | (15–85) | 23 | (-8–54) |
| | 1986–89 | 1.78 | (1.48–2.15) | 1.38 | (1.15–1.66) | 96 | (64–129) | 48 | (21–74) |
| | 1991–94 | 1.56 | (1.31–1.87) | 1.51 | (1.26–1.82) | 62 | (37–88) | 57 | (30–83) |
| | 1996–99 | 1.74 | (1.46–2.06) | 1.41 | (1.18–1.70) | 73 | (49–96) | 41 | (19–63) |
| 60–77 years | 1981–84 | 1.18 | (1.04–1.34) | 1.02 | (0.88–1.19) | 128 | (35–221) | 16 | (-93–125) |
| | 1986–89 | 1.25 | (1.10–1.43) | 1.11 | (0.96–1.28) | 158 | (73–242) | 66 | (-25–158) |
| | 1991–94 | 1.38 | (1.22–1.57) | 1.18 | (1.02–1.36) | 195 | (127–263) | 92 | (12–171) |
| | 1996–99 | 1.47 | (1.27–1.71) | 1.23 | (1.04–1.45) | 192 | (127–256) | 93 | (20–165) |

**Table 54:** Cardiovascular disease mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| CVD: males | | | | | | | |
| 25–77 years | 1981–84 | 614 | (591–637) | 511 | (485–536) | 446 | (421–471) |
| | 1986–89 | 522 | (504–541) | 451 | (432–469) | 349 | (327–372) |
| | 1991–94 | 436 | (421–451) | 352 | (334–370) | 270 | (251–288) |
| | 1996–99 | 343 | (330–356) | 273 | (258–288) | 203 | (188–219) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 47.2 | (36.5–57.9) | 43.4 | (34.2–52.5) | 37.6 | (27.8–47.4) |
| | 1986–89 | 33.4 | (25.3–41.4) | 39.2 | (31.5–46.9) | 24.1 | (17.3–30.8) |
| | 1991–94 | 37.0 | (29.5–44.5) | 28.8 | (22.4–35.2) | 23.8 | (17.7–29.9) |
| | 1996–99 | 31.4 | (24.6–38.2) | 25.8 | (19.3–32.3) | 19.2 | (14.3–24.0) |
| | P (trend) | 0.24 | – | < .01 | – | 0.11 | – |
| 45–59 years | 1981–84 | 478 | (426–530) | 412 | (376–448) | 342 | (314–371) |
| | 1986–89 | 390 | (346–433) | 353 | (323–383) | 292 | (266–319) |
| | 1991–94 | 348 | (314–383) | 270 | (242–298) | 192 | (172–213) |
| | 1996–99 | 283 | (253–312) | 213 | (189–237) | 128 | (114–142) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 2262 | (2178–2347) | 1852 | (1741–1964) | 1640 | (1526–1754) |
| | 1986–89 | 1964 | (1893–2035) | 1645 | (1564–1726) | 1269 | (1167–1371) |
| | 1991–94 | 1587 | (1532–1643) | 1298 | (1220–1376) | 1007 | (924–1091) |
| | 1996–99 | 1231 | (1182–1279) | 992 | (927–1056) | 778 | (707–849) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| CVD: females | | | | | | | |
| 25–77 years | 1981–84 | 318 | (304–332) | 255 | (236–275) | 231 | (209–253) |
| | 1986–89 | 276 | (264–288) | 220 | (206–234) | 189 | (169–209) |
| | 1991–94 | 220 | (210–229) | 183 | (169–198) | 143 | (127–158) |
| | 1996–99 | 158 | (150–166) | 125 | (115–135) | 113 | (98.3–127) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 19.1 | (13.0–25.2) | 24.2 | (17.1–31.3) | 16.3 | (9.7–22.9) |
| | 1986–89 | 13.3 | (8.7–17.9) | 11.3 | (7.2–15.5) | 8.3 | (3.5–13.2) |
| | 1991–94 | 16.2 | (11.6–20.7) | 12.2 | (8.0–16.4) | 13.3 | (7.7–19.0) |
| | 1996–99 | 13.2 | (9.5–16.9) | 10.1 | (6.1–14.2) | 9.1 | (5.2–12.9) |
| | P (trend) | 0.38 | – | 0.31 | – | 0.49 | – |
| 45–59 years | 1981–84 | 190 | (162–217) | 145 | (121–169) | 122 | (102–142) |
| | 1986–89 | 161 | (138–185) | 128 | (109–146) | 75.9 | (61.2–90.6) |
| | 1991–94 | 140 | (121–159) | 97.6 | (80.4–115) | 54.6 | (43.2–66.1) |
| | 1996–99 | 105 | (89.3–121) | 74.0 | (60.3–87.6) | 36.8 | (29.0–44.6) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 1163 | (1111–1215) | 921 | (839–1003) | 857 | (763–951) |
| | 1986–89 | 1021 | (976–1066) | 812 | (754–871) | 737 | (652–823) |
| | 1991–94 | 786 | (751–822) | 680 | (621–740) | 544 | (478–610) |
| | 1996–99 | 558 | (528–587) | 452 | (410–493) | 440 | (377–502) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |

**Table 55:** Cardiovascular disease mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| CVD: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.38 | (1.29–1.47) | 1.14 | (1.06–1.23) | 168 | (134–202) | 65 | (29–100) |
| | 1986–89 | 1.50 | (1.39–1.61) | 1.29 | (1.19–1.39) | 173 | (144–202) | 101 | (72–130) |
| | 1991–94 | 1.62 | (1.50–1.75) | 1.31 | (1.20–1.42) | 167 | (143–190) | 83 | (57–108) |
| | 1996–99 | 1.69 | (1.55–1.83) | 1.34 | (1.22–1.47) | 140 | (120–160) | 69 | (48–91) |
| 25–44 years | 1981–84 | 1.25 | (0.89–1.77) | 1.15 | (0.82–1.61) | 10 | (-5–24) | 6 | (-8–19) |
| | 1986–89 | 1.39 | (0.96–2.01) | 1.63 | (1.16–2.29) | 9 | (-1–20) | 15 | (5–25) |
| | 1991–94 | 1.56 | (1.12–2.16) | 1.21 | (0.86–1.70) | 13 | (4–23) | 5 | (-4–14) |
| | 1996–99 | 1.64 | (1.18–2.29) | 1.35 | (0.94–1.93) | 12 | (4–21) | 7 | (-1–15) |
| 45–59 years | 1981–84 | 1.40 | (1.22–1.60) | 1.20 | (1.06–1.36) | 136 | (77–195) | 69 | (23–115) |
| | 1986–89 | 1.33 | (1.16–1.54) | 1.21 | (1.07–1.37) | 97 | (47–148) | 61 | (20–101) |
| | 1991–94 | 1.81 | (1.57–2.09) | 1.40 | (1.21–1.63) | 156 | (116–196) | 78 | (43–112) |
| | 1996–99 | 2.21 | (1.90–2.57) | 1.66 | (1.42–1.94) | 155 | (122–187) | 85 | (57–113) |
| 60–77 years | 1981–84 | 1.38 | (1.27–1.49) | 1.13 | (1.03–1.24) | 622 | (480–764) | 212 | (52–372) |
| | 1986–89 | 1.55 | (1.42–1.69) | 1.30 | (1.18–1.42) | 694 | (570–819) | 376 | (246–506) |
| | 1991–94 | 1.58 | (1.44–1.72) | 1.29 | (1.16–1.43) | 580 | (480–680) | 291 | (177–405) |
| | 1996–99 | 1.58 | (1.43–1.75) | 1.27 | (1.14–1.43) | 453 | (367–539) | 214 | (118–310) |
| CVD: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.38 | (1.24–1.53) | 1.10 | (0.98–1.25) | 87 | (61–113) | 24 | (-6–54) |
| | 1986–89 | 1.46 | (1.31–1.64) | 1.17 | (1.03–1.32) | 87 | (64–111) | 31 | (7–56) |
| | 1991–94 | 1.54 | (1.37–1.73) | 1.28 | (1.12–1.47) | 77 | (59–95) | 41 | (20–62) |
| | 1996–99 | 1.40 | (1.22–1.61) | 1.11 | (0.95–1.29) | 46 | (29–62) | 12 | (-5–30) |
| 25–44 years | 1981–84 | 1.17 | (0.70–1.96) | 1.48 | (0.90–2.44) | 3 | (-6–12) | 8 | (-2–18) |
| | 1986–89 | 1.60 | (0.81–3.14) | 1.36 | (0.69–2.71) | 5 | (-2–12) | 3 | (-3–9) |
| | 1991–94 | 1.21 | (0.73–2.02) | 0.91 | (0.53–1.58) | 3 | (-4–10) | -1 | (-8–6) |
| | 1996–99 | 1.46 | (0.87–2.43) | 1.12 | (0.62–2.01) | 4 | (-1–10) | 1 | (-5–7) |
| 45–59 years | 1981–84 | 1.55 | (1.25–1.94) | 1.19 | (0.94–1.50) | 68 | (33–102) | 23 | (-8–54) |
| | 1986–89 | 2.13 | (1.67–2.71) | 1.69 | (1.32–2.15) | 86 | (58–114) | 52 | (28–76) |
| | 1991–94 | 2.56 | (2.00–3.28) | 1.79 | (1.36–2.35) | 85 | (63–107) | 43 | (22–64) |
| | 1996–99 | 2.85 | (2.20–3.69) | 2.01 | (1.52–2.66) | 68 | (51–86) | 37 | (22–53) |
| 60–77 years | 1981–84 | 1.36 | (1.21–1.53) | 1.07 | (0.93–1.24) | 306 | (198–413) | 64 | (-61–188) |
| | 1986–89 | 1.38 | (1.22–1.57) | 1.10 | (0.96–1.26) | 284 | (187–381) | 75 | (-29–179) |
| | 1991–94 | 1.44 | (1.27–1.64) | 1.25 | (1.08–1.45) | 242 | (167–317) | 136 | (47–225) |
| | 1996–99 | 1.27 | (1.09–1.48) | 1.03 | (0.87–1.22) | 118 | (49–187) | 12 | (-63–87) |

**Table 56:** Ischaemic heart disease mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| IHD: males | | | | | | | |
| 25–77 years | 1981–84 | 429 | (410–448) | 378 | (357–399) | 332 | (310–353) |
| | 1986–89 | 376 | (360–392) | 334 | (318–350) | 253 | (235–271) |
| | 1991–94 | 310 | (297–322) | 247 | (232–262) | 192 | (178–207) |
| | 1996–99 | 237 | (227–248) | 187 | (174–199) | 142 | (129–154) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 23.0 | (15.6–30.4) | 27.4 | (20.6–34.2) | 24.3 | (16.5–32.0) |
| | 1986–89 | 19.3 | (13.3–25.2) | 23.4 | (17.9–28.9) | 15.1 | (10.1–20.2) |
| | 1991–94 | 22.7 | (16.9–28.4) | 17.1 | (12.2–21.9) | 15.5 | (10.2–20.7) |
| | 1996–99 | 17.9 | (13.0–22.9) | 15.2 | (10.3–20.1) | 10.8 | (7.3–14.3) |
| | P (trend) | 0.37 | – | < .01 | – | 0.06 | – |
| 45–59 years | 1981–84 | 337 | (294–379) | 333 | (300–365) | 279 | (254–304) |
| | 1986–89 | 292 | (255–330) | 284 | (258–311) | 231 | (208–254) |
| | 1991–94 | 262 | (231–292) | 202 | (178–227) | 152 | (134–169) |
| | 1996–99 | 197 | (173–222) | 153 | (133–173) | 101 | (89.2–114) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 1603 | (1532–1674) | 1349 | (1255–1443) | 1199 | (1103–1295) |
| | 1986–89 | 1409 | (1349–1469) | 1206 | (1138–1275) | 901 | (817–985) |
| | 1991–94 | 1117 | (1071–1164) | 900 | (836–965) | 705 | (638–771) |
| | 1996–99 | 860 | (819–900) | 677 | (623–730) | 533 | (475–590) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| IHD: females | | | | | | | |
| 25–77 years | 1981–84 | 192 | (181–202) | 157 | (142–172) | 128 | (112–143) |
| | 1986–89 | 174 | (165–183) | 135 | (124–145) | 114 | (98.5–129) |
| | 1991–94 | 131 | (124–139) | 107 | (95.7–117) | 78.2 | (66.8–89.7) |
| | 1996–99 | 88.7 | (82.8–94.5) | 66.6 | (59.3–74.0) | 56.3 | (46.5–66.2) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 5.6 | (2.2–9.0) | 4.9 | (1.8–7.9) | 5.3 | (1.3–9.2) |
| | 1986–89 | 3.6 | (1.2–6.0) | 3.6 | (1.5–5.6) | 2.9 | (0.8–5.0) |
| | 1991–94 | 3.0 | (1.1–5.0) | 3.5 | (1.4–5.6) | 4.0 | (0.8–7.1) |
| | 1996–99 | 3.5 | (1.7–5.4) | 4.1 | (1.5–6.8) | 2.1 | (0.0–4.2) |
| | P (trend) | 0.37 | – | 0.63 | – | 0.28 | – |
| 45–59 years | 1981–84 | 97.9 | (78.2–118) | 67.0 | (51.3–82.7) | 67.2 | (53.0–81.5) |
| | 1986–89 | 88.7 | (71.5–106) | 74.1 | (60.5–87.7) | 37.1 | (27.0–47.2) |
| | 1991–94 | 69.4 | (56.4–82.4) | 40.6 | (29.5–51.7) | 25.7 | (18.2–33.2) |
| | 1996–99 | 52.2 | (41.2–63.2) | 36.7 | (27.1–46.4) | 18.4 | (12.4–24.3) |
| | P (trend) | < .01 | – | 0.06 | – | 0.06 | – |
| 60–77 years | 1981–84 | 731 | (691–772) | 613 | (547–679) | 482 | (415–549) |
| | 1986–89 | 669 | (633–705) | 509 | (464–554) | 458 | (391–525) |
| | 1991–94 | 501 | (473–529) | 421 | (375–468) | 310 | (261–360) |
| | 1996–99 | 329 | (307–352) | 247 | (216–277) | 226 | (183–268) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |

**Table 57:** Ischaemic heart disease mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| IHD: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.29 | (1.20–1.40) | 1.14 | (1.05–1.24) | 97 | (69–126) | 46 | (16–77) |
| | 1986–89 | 1.49 | (1.37–1.62) | 1.32 | (1.21–1.44) | 123 | (98–147) | 81 | (57–106) |
| | 1991–94 | 1.61 | (1.47–1.75) | 1.28 | (1.16–1.41) | 117 | (98–137) | 54 | (33–75) |
| | 1996–99 | 1.68 | (1.52–1.85) | 1.32 | (1.18–1.47) | 96 | (79–112) | 45 | (28–63) |
| 25–44 years | 1981–84 | 0.95 | (0.60–1.49) | 1.13 | (0.75–1.69) | -1 | (-12–9) | 3 | (-7–13) |
| | 1986–89 | 1.27 | (0.81–2.01) | 1.55 | (1.03–2.33) | 4 | (-4–12) | 8 | (1–16) |
| | 1991–94 | 1.46 | (0.96–2.24) | 1.10 | (0.71–1.72) | 7 | (-1–15) | 2 | (-6–9) |
| | 1996–99 | 1.67 | (1.09–2.56) | 1.42 | (0.90–2.24) | 7 | (1–13) | 5 | (-2–11) |
| 45–59 years | 1981–84 | 1.21 | (1.03–1.41) | 1.19 | (1.04–1.36) | 58 | (8–107) | 54 | (13–95) |
| | 1986–89 | 1.27 | (1.08–1.49) | 1.23 | (1.07–1.41) | 62 | (18–105) | 54 | (18–89) |
| | 1991–94 | 1.72 | (1.46–2.03) | 1.33 | (1.13–1.58) | 110 | (75–145) | 51 | (21–81) |
| | 1996–99 | 1.94 | (1.63–2.31) | 1.51 | (1.26–1.80) | 96 | (68–123) | 51 | (28–75) |
| 60–77 years | 1981–84 | 1.34 | (1.22–1.47) | 1.13 | (1.01–1.25) | 404 | (285–524) | 150 | (16–284) |
| | 1986–89 | 1.56 | (1.41–1.73) | 1.34 | (1.20–1.49) | 508 | (405–611) | 306 | (197–414) |
| | 1991–94 | 1.59 | (1.43–1.76) | 1.28 | (1.13–1.44) | 413 | (332–494) | 196 | (103–288) |
| | 1996–99 | 1.61 | (1.43–1.82) | 1.27 | (1.11–1.45) | 327 | (257–397) | 144 | (66–222) |
| IHD: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.50 | (1.31–1.71) | 1.23 | (1.05–1.44) | 64 | (45–83) | 29 | (7–51) |
| | 1986–89 | 1.53 | (1.33–1.77) | 1.18 | (1.01–1.38) | 60 | (43–78) | 21 | (2–39) |
| | 1991–94 | 1.68 | (1.44–1.96) | 1.36 | (1.14–1.63) | 53 | (40–67) | 28 | (13–44) |
| | 1996–99 | 1.57 | (1.31–1.90) | 1.18 | (0.96–1.45) | 32 | (21–44) | 10 | (-2–23) |
| 25–44 years | 1981–84 | 1.06 | (0.41–2.78) | 0.92 | (0.35–2.45) | 0 | (-5–6) | -0 | (-5–5) |
| | 1986–89 | 1.22 | (0.46–3.26) | 1.21 | (0.49–3.04) | 1 | (-3–4) | 1 | (-2–4) |
| | 1991–94 | 0.77 | (0.28–2.12) | 0.88 | (0.32–2.37) | -1 | (-5–3) | -1 | (-4–3) |
| | 1996–99 | 1.69 | (0.55–5.20) | 1.98 | (0.61–6.43) | 1 | (-1–4) | 2 | (-1–5) |
| 45–59 years | 1981–84 | 1.46 | (1.09–1.95) | 1.00 | (0.73–1.37) | 31 | (6–55) | -0 | (-21–21) |
| | 1986–89 | 2.39 | (1.71–3.34) | 2.00 | (1.44–2.77) | 52 | (32–72) | 37 | (20–54) |
| | 1991–94 | 2.70 | (1.91–3.82) | 1.58 | (1.06–2.35) | 44 | (29–59) | 15 | (2–28) |
| | 1996–99 | 2.84 | (1.93–4.18) | 2.00 | (1.32–3.03) | 34 | (21–46) | 18 | (7–30) |
| 60–77 years | 1981–84 | 1.52 | (1.31–1.76) | 1.27 | (1.07–1.52) | 249 | (171–327) | 131 | (38–225) |
| | 1986–89 | 1.46 | (1.25–1.70) | 1.11 | (0.94–1.32) | 211 | (135–286) | 51 | (-30–131) |
| | 1991–94 | 1.61 | (1.36–1.91) | 1.36 | (1.12–1.65) | 191 | (134–248) | 111 | (43–179) |
| | 1996–99 | 1.46 | (1.19–1.79) | 1.09 | (0.87–1.37) | 103 | (55–152) | 21 | (-32–74) |

**Table 58:** Stroke mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Stroke: males | | | | | | | |
| 25–77 years | 1981–84 | 95.4 | (86.3–105) | 65.6 | (55.9–75.3) | 53.6 | (44.2–63.0) |
| | 1986–89 | 71.4 | (64.4–78.5) | 53.7 | (46.9–60.5) | 51.9 | (42.1–61.6) |
| | 1991–94 | 57.5 | (52.0–63.0) | 49.0 | (42.1–55.9) | 35.9 | (27.7–44.0) |
| | 1996–99 | 44.8 | (40.0–49.7) | 33.9 | (28.4–39.5) | 23.0 | (17.2–28.7) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 45–59 years | 1981–84 | 62.2 | (42.1–82.3) | 39.1 | (27.9–50.2) | 24.1 | (15.9–32.2) |
| | 1986–89 | 42.9 | (28.1–57.7) | 24.7 | (16.2–33.1) | 27.4 | (19.2–35.5) |
| | 1991–94 | 35.3 | (24.2–46.3) | 29.9 | (20.3–39.4) | 20.0 | (12.8–27.2) |
| | 1996–99 | 31.5 | (21.4–41.7) | 20.6 | (13.0–28.2) | 7.5 | (3.9–11.1) |
| | P (trend) | 0.07 | – | 0.21 | – | 0.07 | – |
| 60–77 years | 1981–84 | 366 | (331–400) | 254 | (210–298) | 218 | (174–262) |
| | 1986–89 | 283 | (256–311) | 216 | (186–246) | 208 | (162–253) |
| | 1991–94 | 220 | (199–242) | 190 | (159–220) | 144 | (106–183) |
| | 1996–99 | 168 | (149–186) | 134 | (109–159) | 95.4 | (68.2–123) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| Stroke: females | | | | | | | |
| 25–77 years | 1981–84 | 74.5 | (67.4–81.5) | 64.2 | (53.7–74.7) | 81.0 | (66.8–95.3) |
| | 1986–89 | 57.5 | (51.9–63.2) | 47.8 | (41.0–54.6) | 44.4 | (34.9–53.8) |
| | 1991–94 | 48.3 | (43.6–53.0) | 46.0 | (38.8–53.1) | 40.5 | (31.9–49.0) |
| | 1996–99 | 32.9 | (29.2–36.6) | 29.0 | (24.1–34.0) | 27.9 | (20.5–35.4) |
| | P (trend) | < .01 | – | < .01 | – | 0.07 | – |
| 45–59 years | 1981–84 | 45.9 | (31.5–60.2) | 39.8 | (26.4–53.2) | 32.1 | (20.3–43.9) |
| | 1986–89 | 42.7 | (30.1–55.4) | 22.1 | (14.4–29.8) | 22.7 | (14.6–30.8) |
| | 1991–94 | 33.4 | (24.1–42.8) | 35.2 | (24.9–45.5) | 16.5 | (10.4–22.7) |
| | 1996–99 | 25.1 | (17.3–32.9) | 22.3 | (14.8–29.7) | 9.4 | (6.0–12.8) |
| | P (trend) | < .01 | – | 0.59 | – | < .01 | – |
| 60–77 years | 1981–84 | 272 | (245–298) | 220 | (177–263) | 302 | (241–363) |
| | 1986–89 | 200 | (179–220) | 179 | (150–207) | 163 | (123–203) |
| | 1991–94 | 162 | (145–179) | 158 | (129–188) | 153 | (116–190) |
| | 1996–99 | 109 | (96.0–122) | 98.3 | (78.6–118) | 111 | (77.8–144) |
| | P (trend) | < .01 | – | < .01 | – | 0.07 | – |

**Table 59:** Stroke mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Stroke: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.78 | (1.46–2.18) | 1.22 | (0.97–1.54) | 42 | (29–55) | 12 | (-2–26) |
| | 1986–89 | 1.38 | (1.11–1.70) | 1.04 | (0.83–1.30) | 20 | (8–32) | 2 | (-10–14) |
| | 1991–94 | 1.60 | (1.25–2.05) | 1.36 | (1.04–1.78) | 22 | (12–32) | 13 | (2–24) |
| | 1996–99 | 1.95 | (1.49–2.56) | 1.48 | (1.10–1.99) | 22 | (14–29) | 11 | (3–19) |
| 45–59 years | 1981–84 | 2.58 | (1.62–4.12) | 1.62 | (1.04–2.53) | 38 | (16–60) | 15 | (1–29) |
| | 1986–89 | 1.57 | (0.99–2.47) | 0.90 | (0.57–1.42) | 16 | (-1–32) | -3 | (-14–9) |
| | 1991–94 | 1.77 | (1.10–2.85) | 1.50 | (0.92–2.42) | 15 | (2–29) | 10 | (-2–22) |
| | 1996–99 | 4.20 | (2.35–7.49) | 2.74 | (1.49–5.04) | 24 | (13–35) | 13 | (5–22) |
| 60–77 years | 1981–84 | 1.68 | (1.34–2.10) | 1.17 | (0.89–1.52) | 148 | (92–204) | 36 | (-26–98) |
| | 1986–89 | 1.36 | (1.07–1.73) | 1.04 | (0.80–1.35) | 76 | (22–129) | 8 | (-47–63) |
| | 1991–94 | 1.53 | (1.15–2.03) | 1.32 | (0.96–1.80) | 76 | (32–120) | 45 | (-4–95) |
| | 1996–99 | 1.76 | (1.30–2.39) | 1.41 | (1.00–1.98) | 73 | (40–105) | 39 | (2–76) |
| Stroke: females | | | | | | | | | |
| 25–77 years | 1981–84 | 0.92 | (0.75–1.12) | 0.79 | (0.62–1.01) | -7 | (-23–9) | -17 | (-35–1) |
| | 1986–89 | 1.30 | (1.03–1.64) | 1.08 | (0.83–1.39) | 13 | (2–24) | 3 | (-8–15) |
| | 1991–94 | 1.19 | (0.94–1.51) | 1.14 | (0.87–1.48) | 8 | (-2–18) | 6 | (-6–17) |
| | 1996–99 | 1.18 | (0.88–1.57) | 1.04 | (0.76–1.43) | 5 | (-3–13) | 1 | (-8–10) |
| 45–59 years | 1981–84 | 1.43 | (0.88–2.32) | 1.24 | (0.75–2.04) | 14 | (-5–32) | 8 | (-10–26) |
| | 1986–89 | 1.88 | (1.18–3.00) | 0.97 | (0.59–1.60) | 20 | (5–35) | -1 | (-12–11) |
| | 1991–94 | 2.02 | (1.27–3.23) | 2.13 | (1.33–3.42) | 17 | (6–28) | 19 | (7–31) |
| | 1996–99 | 2.67 | (1.66–4.30) | 2.37 | (1.45–3.87) | 16 | (7–24) | 13 | (5–21) |
| 60–77 years | 1981–84 | 0.90 | (0.72–1.13) | 0.73 | (0.55–0.97) | -30 | (-97–36) | -82 | (-156–-7) |
| | 1986–89 | 1.22 | (0.94–1.59) | 1.09 | (0.82–1.47) | 36 | (-9–81) | 16 | (-34–65) |
| | 1991–94 | 1.06 | (0.81–1.38) | 1.04 | (0.76–1.41) | 9 | (-32–50) | 5 | (-42–53) |
| | 1996–99 | 0.98 | (0.71–1.36) | 0.89 | (0.62–1.27) | -2 | (-37–34) | -12 | (-51–26) |

**Table 60:** Chronic lung disease mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Chronic lung disease: males | | | | | | | |
| 25–77 years | 1981–84 | 87.6 | (79.2–96.0) | 56.8 | (47.6–66.1) | 41.0 | (33.8–48.3) |
| | 1986–89 | 80.8 | (73.6–88.0) | 47.7 | (41.2–54.1) | 37.4 | (29.0–45.8) |
| | 1991–94 | 54.9 | (49.7–60.0) | 35.2 | (29.2–41.2) | 18.5 | (13.3–23.8) |
| | 1996–99 | 55.9 | (50.8–60.9) | 33.3 | (27.9–38.7) | 14.6 | (10.5–18.7) |
| | P (trend) | 0.06 | – | < .01 | – | < .01 | – |
| 45–59 years | 1981–84 | 53.8 | (36.6–70.9) | 34.6 | (24.3–45.0) | 25.2 | (16.9–33.5) |
| | 1986–89 | 40.0 | (26.2–53.8) | 12.7 | (7.1–18.3) | 11.7 | (5.9–17.4) |
| | 1991–94 | 31.5 | (20.9–42.1) | 7.0 | (2.4–11.7) | 9.9 | (4.8–14.9) |
| | 1996–99 | 28.3 | (18.7–37.9) | 13.2 | (7.0–19.3) | 5.0 | (2.5–7.6) |
| | P (trend) | < .01 | – | 0.45 | – | 0.06 | – |
| 60–77 years | 1981–84 | 340 | (307–373) | 221 | (178–263) | 158 | (125–191) |
| | 1986–89 | 334 | (305–364) | 199 | (170–227) | 161 | (121–200) |
| | 1991–94 | 224 | (203–245) | 158 | (130–187) | 76.1 | (51.3–101) |
| | 1996–99 | 233 | (211–254) | 144 | (119–169) | 64.2 | (44.6–83.8) |
| | P (trend) | 0.06 | – | < .01 | – | 0.06 | – |
| Chronic lung disease: females | | | | | | | |
| 25–77 years | 1981–84 | 31.7 | (27.1–36.3) | 28.6 | (22.0–35.2) | 22.3 | (15.7–28.8) |
| | 1986–89 | 41.1 | (36.1–46.2) | 32.2 | (26.9–37.6) | 24.9 | (17.3–32.6) |
| | 1991–94 | 39.9 | (35.8–43.9) | 25.5 | (20.5–30.4) | 15.8 | (10.6–21.0) |
| | 1996–99 | 38.0 | (34.3–41.7) | 27.0 | (22.2–31.8) | 17.9 | (12.4–23.3) |
| | P (trend) | 0.45 | – | 0.44 | – | 0.31 | – |
| 45–59 years | 1981–84 | 34.8 | (23.1–46.5) | 30.2 | (19.0–41.4) | 14.2 | (7.7–20.7) |
| | 1986–89 | 43.3 | (30.2–56.4) | 24.5 | (15.9–33.1) | 11.4 | (5.6–17.1) |
| | 1991–94 | 30.3 | (21.6–39.0) | 18.1 | (10.8–25.3) | 7.0 | (3.4–10.7) |
| | 1996–99 | 16.6 | (10.7–22.5) | 13.7 | (7.8–19.6) | 5.0 | (1.5–8.5) |
| | P (trend) | 0.06 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 94.0 | (79.6–108) | 84.5 | (58.8–110) | 74.4 | (47.5–101) |
| | 1986–89 | 125 | (109–140) | 109 | (87.5–130) | 93.6 | (60.6–127) |
| | 1991–94 | 137 | (123–152) | 92.0 | (71.3–113) | 59.7 | (37.2–82.1) |
| | 1996–99 | 148 | (133–163) | 105 | (84.8–125) | 70.8 | (46.9–94.6) |
| | P (trend) | < .01 | – | 0.57 | – | 0.57 | – |

**Table 61:** Chronic lung disease mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Chronic lung disease: males | | | | | | | | | |
| 25–77 years | 1981–84 | 2.13 | (1.75–2.61) | 1.38 | (1.09–1.76) | 47 | (36–58) | 16 | (4–28) |
| | 1986–89 | 2.16 | (1.70–2.75) | 1.28 | (0.98–1.66) | 43 | (32–54) | 10 | (-0–21) |
| | 1991–94 | 2.96 | (2.19–4.00) | 1.90 | (1.36–2.65) | 36 | (29–44) | 17 | (9–25) |
| | 1996–99 | 3.82 | (2.84–5.12) | 2.27 | (1.65–3.14) | 41 | (35–48) | 19 | (12–25) |
| 45–59 years | 1981–84 | 2.13 | (1.35–3.38) | 1.38 | (0.88–2.15) | 29 | (10–48) | 10 | (-4–23) |
| | 1986–89 | 3.42 | (1.88–6.24) | 1.09 | (0.56–2.11) | 28 | (13–43) | 1 | (-7–9) |
| | 1991–94 | 3.19 | (1.73–5.89) | 0.71 | (0.31–1.64) | 22 | (10–33) | -3 | (-10–4) |
| | 1996–99 | 5.61 | (3.03–10.4) | 2.61 | (1.31–5.22) | 23 | (13–33) | 8 | (2–15) |
| 60–77 years | 1981–84 | 2.16 | (1.71–2.72) | 1.40 | (1.05–1.86) | 183 | (136–229) | 63 | (9–117) |
| | 1986–89 | 2.08 | (1.60–2.70) | 1.24 | (0.93–1.64) | 174 | (125–223) | 38 | (-11–87) |
| | 1991–94 | 2.94 | (2.10–4.13) | 2.08 | (1.44–3.02) | 148 | (116–180) | 82 | (45–120) |
| | 1996–99 | 3.62 | (2.63–4.98) | 2.24 | (1.57–3.18) | 168 | (140–197) | 79 | (48–111) |
| Chronic lung disease: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.42 | (1.03–1.97) | 1.28 | (0.88–1.87) | 9 | (2–17) | 6 | (-3–16) |
| | 1986–89 | 1.65 | (1.19–2.29) | 1.29 | (0.91–1.83) | 16 | (7–25) | 7 | (-2–17) |
| | 1991–94 | 2.52 | (1.79–3.57) | 1.61 | (1.10–2.37) | 24 | (18–31) | 10 | (2–17) |
| | 1996–99 | 2.13 | (1.54–2.94) | 1.51 | (1.06–2.15) | 20 | (14–27) | 9 | (2–16) |
| 45–59 years | 1981–84 | 2.45 | (1.39–4.34) | 2.13 | (1.18–3.84) | 21 | (7–34) | 16 | (3–29) |
| | 1986–89 | 3.81 | (2.12–6.86) | 2.16 | (1.17–3.99) | 32 | (18–46) | 13 | (3–24) |
| | 1991–94 | 4.30 | (2.38–7.79) | 2.56 | (1.33–4.94) | 23 | (14–33) | 11 | (3–19) |
| | 1996–99 | 3.31 | (1.51–7.26) | 2.74 | (1.21–6.22) | 12 | (5–19) | 9 | (2–16) |
| 60–77 years | 1981–84 | 1.26 | (0.85–1.87) | 1.14 | (0.71–1.82) | 20 | (-11–50) | 10 | (-27–47) |
| | 1986–89 | 1.33 | (0.91–1.93) | 1.16 | (0.78–1.74) | 31 | (-6–67) | 15 | (-24–54) |
| | 1991–94 | 2.30 | (1.55–3.39) | 1.54 | (0.99–2.39) | 77 | (51–104) | 32 | (2–63) |
| | 1996–99 | 2.09 | (1.47–2.98) | 1.49 | (1.01–2.19) | 77 | (49–106) | 34 | (3–66) |

**Table 62:** Total cancer mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Cancer: males | | | | | | | |
| 25–77 years | 1981–84 | 315 | (298–331) | 270 | (252–288) | 246 | (228–264) |
| | 1986–89 | 316 | (301–331) | 272 | (258–286) | 231 | (214–248) |
| | 1991–94 | 310 | (298–323) | 269 | (253–284) | 224 | (207–240) |
| | 1996–99 | 300 | (288–313) | 247 | (233–261) | 197 | (183–210) |
| | P (trend) | 0.06 | – | 0.16 | – | < .01 | – |
| 25–44 years | 1981–84 | 37.2 | (28.0–46.5) | 32.1 | (24.4–39.8) | 25.9 | (19.5–32.3) |
| | 1986–89 | 33.7 | (26.0–41.4) | 20.4 | (15.1–25.7) | 25.8 | (18.9–32.6) |
| | 1991–94 | 32.0 | (24.5–39.6) | 24.3 | (18.4–30.2) | 26.0 | (20.4–31.6) |
| | 1996–99 | 30.0 | (23.0–37.1) | 18.9 | (13.7–24.1) | 19.3 | (14.5–24.0) |
| | P (trend) | < .01 | – | 0.25 | – | 0.16 | – |
| 45–59 years | 1981–84 | 283 | (243–322) | 228 | (202–254) | 221 | (198–245) |
| | 1986–89 | 262 | (227–297) | 227 | (203–250) | 188 | (168–207) |
| | 1991–94 | 241 | (213–270) | 220 | (194–245) | 171 | (154–189) |
| | 1996–99 | 228 | (201–254) | 179 | (157–201) | 150 | (135–164) |
| | P (trend) | < .01 | – | 0.06 | – | < .01 | – |
| 60–77 years | 1981–84 | 1079 | (1021–1137) | 941 | (862–1020) | 850 | (771–929) |
| | 1986–89 | 1119 | (1066–1172) | 983 | (923–1043) | 820 | (741–899) |
| | 1991–94 | 1123 | (1076–1169) | 967 | (901–1033) | 805 | (729–880) |
| | 1996–99 | 1096 | (1050–1142) | 926 | (865–987) | 718 | (654–781) |
| | P (trend) | 0.76 | – | 0.48 | – | 0.06 | – |
| Cancer: females | | | | | | | |
| 25–77 years | 1981–84 | 222 | (210–235) | 220 | (204–236) | 205 | (187–222) |
| | 1986–89 | 229 | (218–241) | 227 | (214–240) | 192 | (175–210) |
| | 1991–94 | 232 | (222–242) | 216 | (202–230) | 189 | (174–204) |
| | 1996–99 | 242 | (232–252) | 212 | (199–225) | 172 | (158–186) |
| | P (trend) | < .01 | – | 0.25 | – | < .01 | – |
| 25–44 years | 1981–84 | 41.7 | (33.3–50.2) | 43.0 | (34.7–51.4) | 41.3 | (32.1–50.6) |
| | 1986–89 | 41.2 | (33.6–48.8) | 39.5 | (32.4–46.6) | 28.8 | (22.0–35.7) |
| | 1991–94 | 30.3 | (24.3–36.2) | 34.8 | (27.7–41.9) | 28.3 | (22.8–33.9) |
| | 1996–99 | 37.2 | (30.6–43.8) | 39.9 | (32.3–47.5) | 25.8 | (20.6–31.1) |
| | P (trend) | 0.48 | – | 0.48 | – | 0.16 | – |
| 45–59 years | 1981–84 | 244 | (212–276) | 245 | (217–274) | 203 | (181–226) |
| | 1986–89 | 249 | (219–279) | 231 | (207–255) | 183 | (163–203) |
| | 1991–94 | 240 | (214–265) | 234 | (209–259) | 188 | (169–207) |
| | 1996–99 | 240 | (216–264) | 229 | (205–253) | 175 | (159–191) |
| | P (trend) | 0.25 | – | 0.16 | – | 0.06 | – |
| 60–77 years | 1981–84 | 623 | (586–660) | 609 | (547–671) | 591 | (522–661) |
| | 1986–89 | 650 | (616–685) | 664 | (615–713) | 587 | (516–658) |
| | 1991–94 | 697 | (665–729) | 623 | (572–674) | 568 | (508–628) |
| | 1996–99 | 727 | (693–760) | 599 | (551–646) | 513 | (453–574) |
| | P (trend) | < .01 | – | 0.48 | – | 0.06 | – |

**Table 63:** Total cancer mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Cancer: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.28 | (1.17–1.40) | 1.10 | (0.99–1.21) | 69 | (45–93) | 24 | (-2–49) |
| | 1986–89 | 1.37 | (1.25–1.49) | 1.18 | (1.07–1.29) | 85 | (62–108) | 41 | (18–63) |
| | 1991–94 | 1.39 | (1.28–1.51) | 1.20 | (1.09–1.32) | 87 | (66–108) | 45 | (22–68) |
| | 1996–99 | 1.53 | (1.41–1.66) | 1.26 | (1.15–1.37) | 104 | (85–122) | 50 | (31–70) |
| 25–44 years | 1981–84 | 1.44 | (1.01–2.04) | 1.24 | (0.88–1.75) | 11 | (0–23) | 6 | (-4–16) |
| | 1986–89 | 1.31 | (0.92–1.86) | 0.79 | (0.55–1.15) | 8 | (-2–18) | -5 | (-14–3) |
| | 1991–94 | 1.23 | (0.90–1.70) | 0.93 | (0.68–1.29) | 6 | (-3–15) | -2 | (-10–6) |
| | 1996–99 | 1.56 | (1.11–2.19) | 0.98 | (0.68–1.42) | 11 | (2–19) | -0 | (-7–7) |
| 45–59 years | 1981–84 | 1.28 | (1.07–1.52) | 1.03 | (0.88–1.20) | 62 | (16–107) | 7 | (-29–42) |
| | 1986–89 | 1.40 | (1.18–1.65) | 1.21 | (1.04–1.40) | 74 | (34–114) | 39 | (8–70) |
| | 1991–94 | 1.41 | (1.20–1.65) | 1.28 | (1.10–1.49) | 70 | (36–104) | 48 | (18–79) |
| | 1996–99 | 1.52 | (1.31–1.77) | 1.20 | (1.02–1.40) | 78 | (48–108) | 29 | (3–56) |
| 60–77 years | 1981–84 | 1.27 | (1.14–1.41) | 1.11 | (0.98–1.25) | 229 | (131–327) | 91 | (-21–203) |
| | 1986–89 | 1.36 | (1.23–1.52) | 1.20 | (1.07–1.34) | 299 | (203–394) | 163 | (64–263) |
| | 1991–94 | 1.40 | (1.26–1.55) | 1.20 | (1.07–1.35) | 318 | (230–407) | 163 | (62–263) |
| | 1996–99 | 1.53 | (1.38–1.68) | 1.29 | (1.16–1.44) | 378 | (300–457) | 209 | (120–297) |
| Cancer: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.09 | (0.98–1.20) | 1.07 | (0.96–1.20) | 18 | (-4–39) | 15 | (-9–39) |
| | 1986–89 | 1.19 | (1.08–1.32) | 1.18 | (1.06–1.31) | 37 | (16–57) | 35 | (13–56) |
| | 1991–94 | 1.23 | (1.12–1.34) | 1.14 | (1.03–1.26) | 43 | (25–60) | 27 | (7–47) |
| | 1996–99 | 1.41 | (1.28–1.54) | 1.23 | (1.11–1.37) | 70 | (52–88) | 40 | (21–59) |
| 25–44 years | 1981–84 | 1.01 | (0.75–1.37) | 1.04 | (0.77–1.40) | 0 | (-12–13) | 2 | (-11–14) |
| | 1986–89 | 1.43 | (1.06–1.93) | 1.37 | (1.02–1.84) | 12 | (2–23) | 11 | (1–21) |
| | 1991–94 | 1.07 | (0.81–1.41) | 1.23 | (0.93–1.63) | 2 | (-6–10) | 7 | (-3–16) |
| | 1996–99 | 1.44 | (1.10–1.89) | 1.55 | (1.17–2.04) | 11 | (3–20) | 14 | (5–23) |
| 45–59 years | 1981–84 | 1.20 | (1.01–1.43) | 1.21 | (1.03–1.42) | 41 | (2–80) | 42 | (6–79) |
| | 1986–89 | 1.36 | (1.15–1.60) | 1.26 | (1.08–1.46) | 66 | (30–102) | 48 | (17–79) |
| | 1991–94 | 1.27 | (1.10–1.47) | 1.24 | (1.07–1.44) | 51 | (20–83) | 46 | (14–77) |
| | 1996–99 | 1.37 | (1.20–1.57) | 1.31 | (1.14–1.50) | 65 | (36–94) | 54 | (25–83) |
| 60–77 years | 1981–84 | 1.05 | (0.92–1.20) | 1.03 | (0.88–1.20) | 32 | (-47–111) | 18 | (-76–111) |
| | 1986–89 | 1.11 | (0.97–1.26) | 1.13 | (0.98–1.30) | 63 | (-16–142) | 77 | (-10–163) |
| | 1991–94 | 1.23 | (1.09–1.38) | 1.10 | (0.96–1.25) | 129 | (61–197) | 55 | (-24–134) |
| | 1996–99 | 1.42 | (1.25–1.61) | 1.17 | (1.01–1.35) | 213 | (145–282) | 86 | (9–163) |

**Table 64:** Lung cancer mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Lung: males | | | | | | | |
| 25–77 years | 1981–84 | 102 | (93.1–112) | 82.4 | (72.6–92.2) | 70.7 | (61.1–80.3) |
| | 1986–89 | 102 | (93.4–110) | 75.0 | (67.5–82.4) | 50.4 | (42.8–58.0) |
| | 1991–94 | 87.1 | (80.6–93.6) | 65.4 | (57.6–73.2) | 49.2 | (40.8–57.6) |
| | 1996–99 | 79.4 | (73.3–85.5) | 59.0 | (52.2–65.9) | 34.1 | (28.4–39.8) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 45–59 years | 1981–84 | 96.0 | (73.3–119) | 79.5 | (63.7–95.4) | 55.8 | (43.9–67.7) |
| | 1986–89 | 72.0 | (53.9–90.0) | 67.6 | (54.7–80.5) | 45.0 | (35.4–54.7) |
| | 1991–94 | 65.3 | (50.7–79.9) | 50.4 | (38.3–62.5) | 34.1 | (26.3–42.0) |
| | 1996–99 | 58.0 | (44.8–71.3) | 47.4 | (36.2–58.5) | 22.1 | (16.4–27.7) |
| | P (trend) | 0.06 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 368 | (334–402) | 295 | (252–339) | 270 | (226–314) |
| | 1986–89 | 398 | (365–430) | 279 | (247–311) | 185 | (150–220) |
| | 1991–94 | 339 | (313–365) | 251 | (217–286) | 191 | (152–231) |
| | 1996–99 | 307 | (282–331) | 225 | (194–255) | 135 | (109–162) |
| | P (trend) | 0.06 | – | < .01 | – | 0.06 | – |
| Lung: females | | | | | | | |
| 25–77 years | 1981–84 | 27.3 | (23.1–31.5) | 28.5 | (22.5–34.5) | 26.7 | (19.7–33.7) |
| | 1986–89 | 35.9 | (31.5–40.4) | 31.1 | (26.2–36.0) | 24.4 | (18.5–30.2) |
| | 1991–94 | 40.4 | (36.3–44.5) | 31.8 | (26.4–37.2) | 24.9 | (18.5–31.2) |
| | 1996–99 | 46.2 | (41.9–50.4) | 31.3 | (26.3–36.3) | 21.3 | (16.3–26.4) |
| | P (trend) | < .01 | – | 0.25 | – | 0.06 | – |
| 45–59 years | 1981–84 | 33.9 | (22.6–45.3) | 26.4 | (16.8–36.0) | 24.9 | (15.7–34.1) |
| | 1986–89 | 38.5 | (26.5–50.4) | 30.8 | (21.8–39.7) | 23.2 | (14.8–31.6) |
| | 1991–94 | 39.8 | (29.6–50.0) | 27.7 | (18.8–36.7) | 24.4 | (16.8–32.0) |
| | 1996–99 | 40.1 | (30.3–49.9) | 33.7 | (24.3–43.1) | 20.3 | (14.7–26.0) |
| | P (trend) | 0.06 | – | 0.25 | – | 0.17 | – |
| 60–77 years | 1981–84 | 79.8 | (66.5–93.2) | 96.8 | (72.2–121) | 90.5 | (61.2–120) |
| | 1986–89 | 115 | (99.8–130) | 102 | (82.6–121) | 77.6 | (53.8–102) |
| | 1991–94 | 128 | (114–142) | 105 | (84.0–127) | 76.0 | (49.4–103) |
| | 1996–99 | 152 | (137–167) | 97.0 | (77.4–117) | 66.9 | (45.6–88.2) |
| | P (trend) | < .01 | – | 0.97 | – | < .01 | – |

**Table 65:** Lung cancer mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Lung: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.45 | (1.23–1.70) | 1.17 | (0.97–1.40) | 32 | (18–45) | 12 | (-2–26) |
| | 1986–89 | 2.02 | (1.70–2.39) | 1.49 | (1.24–1.78) | 51 | (40–62) | 25 | (14–35) |
| | 1991–94 | 1.77 | (1.47–2.13) | 1.33 | (1.08–1.64) | 38 | (27–49) | 16 | (5–28) |
| | 1996–99 | 2.33 | (1.94–2.80) | 1.73 | (1.41–2.12) | 45 | (37–54) | 25 | (16–34) |
| 45–59 years | 1981–84 | 1.72 | (1.25–2.37) | 1.43 | (1.07–1.91) | 40 | (15–66) | 24 | (4–44) |
| | 1986–89 | 1.60 | (1.15–2.22) | 1.50 | (1.13–2.00) | 27 | (7–47) | 23 | (6–39) |
| | 1991–94 | 1.91 | (1.39–2.64) | 1.48 | (1.06–2.06) | 31 | (15–48) | 16 | (2–31) |
| | 1996–99 | 2.63 | (1.87–3.70) | 2.15 | (1.52–3.04) | 36 | (22–50) | 25 | (13–38) |
| 60–77 years | 1981–84 | 1.36 | (1.13–1.64) | 1.09 | (0.88–1.36) | 98 | (42–153) | 25 | (-37–87) |
| | 1986–89 | 2.15 | (1.75–2.64) | 1.51 | (1.21–1.88) | 213 | (166–260) | 94 | (47–141) |
| | 1991–94 | 1.77 | (1.42–2.21) | 1.31 | (1.02–1.68) | 148 | (101–195) | 60 | (7–112) |
| | 1996–99 | 2.27 | (1.83–2.80) | 1.66 | (1.31–2.11) | 171 | (135–207) | 89 | (49–130) |
| Lung: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.02 | (0.75–1.39) | 1.07 | (0.76–1.50) | 1 | (-8–9) | 2 | (-7–11) |
| | 1986–89 | 1.48 | (1.13–1.93) | 1.28 | (0.96–1.70) | 12 | (4–19) | 7 | (-1–14) |
| | 1991–94 | 1.62 | (1.23–2.14) | 1.28 | (0.94–1.74) | 16 | (8–23) | 7 | (-1–15) |
| | 1996–99 | 2.17 | (1.68–2.79) | 1.47 | (1.10–1.96) | 25 | (18–32) | 10 | (3–17) |
| 45–59 years | 1981–84 | 1.36 | (0.83–2.24) | 1.06 | (0.63–1.78) | 9 | (-6–24) | 2 | (-12–15) |
| | 1986–89 | 1.66 | (1.03–2.67) | 1.33 | (0.83–2.11) | 15 | (1–30) | 8 | (-5–20) |
| | 1991–94 | 1.63 | (1.09–2.45) | 1.14 | (0.73–1.78) | 15 | (3–28) | 3 | (-8–15) |
| | 1996–99 | 1.97 | (1.36–2.86) | 1.66 | (1.12–2.45) | 20 | (9–31) | 13 | (2–24) |
| 60–77 years | 1981–84 | 0.88 | (0.61–1.27) | 1.07 | (0.71–1.61) | -11 | (-43–22) | 6 | (-32–45) |
| | 1986–89 | 1.48 | (1.06–2.06) | 1.31 | (0.92–1.88) | 37 | (9–65) | 24 | (-6–55) |
| | 1991–94 | 1.68 | (1.17–2.43) | 1.39 | (0.92–2.08) | 52 | (22–82) | 29 | (-5–63) |
| | 1996–99 | 2.28 | (1.63–3.17) | 1.45 | (0.99–2.11) | 85 | (59–111) | 30 | (1–59) |

**Table 66:** Colorectal cancer mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Colorectal: males | | | | | | | |
| 25–77 years | 1981–84 | 43.7 | (37.5–49.8) | 41.7 | (34.6–48.7) | 39.8 | (32.6–46.9) |
| | 1986–89 | 42.6 | (36.9–48.2) | 46.8 | (40.9–52.6) | 35.7 | (29.2–42.2) |
| | 1991–94 | 46.7 | (41.8–51.7) | 43.3 | (37.3–49.3) | 40.1 | (34.4–45.8) |
| | 1996–99 | 48.8 | (43.8–53.7) | 41.0 | (35.3–46.6) | 36.2 | (30.1–42.3) |
| | P (trend) | 0.06 | – | 0.59 | – | 0.70 | – |
| 45–59 years | 1981–84 | 46.6 | (30.3–62.8) | 41.2 | (29.9–52.4) | 47.7 | (37.9–57.5) |
| | 1986–89 | 55.1 | (38.9–71.4) | 40.5 | (30.7–50.4) | 44.1 | (34.8–53.4) |
| | 1991–94 | 43.7 | (31.4–56.1) | 43.6 | (32.6–54.5) | 38.4 | (30.2–46.6) |
| | 1996–99 | 42.6 | (31.0–54.2) | 22.8 | (15.1–30.5) | 26.0 | (20.4–31.7) |
| | P (trend) | 0.38 | – | 0.17 | – | < .01 | – |
| 60–77 years | 1981–84 | 141 | (121–162) | 138 | (108–168) | 125 | (93.3–158) |
| | 1986–89 | 127 | (109–144) | 167 | (142–191) | 112 | (83.3–141) |
| | 1991–94 | 164 | (147–181) | 150 | (124–175) | 137 | (112–162) |
| | 1996–99 | 177 | (159–196) | 165 | (140–190) | 138 | (109–166) |
| | P (trend) | 0.17 | – | 0.47 | – | 0.26 | – |
| Colorectal: females | | | | | | | |
| 25–77 years | 1981–84 | 39.5 | (34.5–44.5) | 32.8 | (26.5–39.0) | 37.3 | (30.0–44.6) |
| | 1986–89 | 35.4 | (31.2–39.7) | 41.5 | (36.0–47.0) | 31.1 | (25.2–37.0) |
| | 1991–94 | 34.1 | (30.4–37.7) | 31.7 | (26.7–36.7) | 29.2 | (24.0–34.4) |
| | 1996–99 | 31.6 | (28.1–35.2) | 31.3 | (26.3–36.3) | 27.4 | (21.7–33.2) |
| | P (trend) | < .01 | – | 0.47 | – | 0.06 | – |
| 45–59 years | 1981–84 | 38.6 | (26.2–51.0) | 36.2 | (26.0–46.4) | 34.0 | (25.9–42.1) |
| | 1986–89 | 34.0 | (23.2–44.8) | 46.3 | (36.0–56.6) | 31.2 | (23.2–39.3) |
| | 1991–94 | 24.5 | (16.7–32.2) | 34.0 | (24.5–43.5) | 26.7 | (20.5–32.9) |
| | 1996–99 | 28.3 | (20.1–36.5) | 34.6 | (25.3–43.8) | 23.5 | (17.7–29.3) |
| | P (trend) | 0.26 | – | 0.59 | – | < .01 | – |
| 60–77 years | 1981–84 | 122 | (106–138) | 94.5 | (69.9–119) | 116 | (85.6–147) |
| | 1986–89 | 116 | (102–131) | 127 | (106–148) | 97.3 | (73.1–122) |
| | 1991–94 | 121 | (107–134) | 99.2 | (80.0–118) | 96.1 | (74.2–118) |
| | 1996–99 | 107 | (94.4–120) | 101 | (81.1–120) | 93.3 | (68.5–118) |
| | P (trend) | 0.17 | – | 0.81 | – | 0.17 | – |

**Table 67:** Colorectal cancer mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Colorectal: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.10 | (0.87–1.38) | 1.05 | (0.82–1.34) | 4 | (-6–13) | 2 | (-8–12) |
| | 1986–89 | 1.19 | (0.95–1.49) | 1.31 | (1.05–1.63) | 7 | (-2–16) | 11 | (2–20) |
| | 1991–94 | 1.16 | (0.98–1.39) | 1.08 | (0.89–1.32) | 7 | (-1–14) | 3 | (-5–12) |
| | 1996–99 | 1.35 | (1.11–1.64) | 1.13 | (0.91–1.41) | 13 | (5–20) | 5 | (-4–13) |
| 45–59 years | 1981–84 | 0.98 | (0.65–1.47) | 0.86 | (0.61–1.22) | -1 | (-20–18) | -7 | (-21–8) |
| | 1986–89 | 1.25 | (0.87–1.80) | 0.92 | (0.67–1.27) | 11 | (-8–30) | -4 | (-17–10) |
| | 1991–94 | 1.14 | (0.80–1.62) | 1.13 | (0.82–1.58) | 5 | (-10–20) | 5 | (-9–19) |
| | 1996–99 | 1.64 | (1.16–2.32) | 0.88 | (0.59–1.31) | 17 | (4–30) | -3 | (-13–6) |
| 60–77 years | 1981–84 | 1.13 | (0.84–1.51) | 1.10 | (0.79–1.54) | 16 | (-22–54) | 13 | (-31–57) |
| | 1986–89 | 1.13 | (0.84–1.51) | 1.48 | (1.10–2.00) | 14 | (-20–48) | 54 | (16–92) |
| | 1991–94 | 1.20 | (0.97–1.48) | 1.09 | (0.85–1.40) | 27 | (-4–57) | 12 | (-24–48) |
| | 1996–99 | 1.29 | (1.02–1.63) | 1.20 | (0.93–1.55) | 40 | (6–74) | 27 | (-11–65) |
| Colorectal: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.06 | (0.84–1.34) | 0.88 | (0.67–1.16) | 2 | (-7–11) | -5 | (-14–5) |
| | 1986–89 | 1.14 | (0.91–1.43) | 1.34 | (1.06–1.68) | 4 | (-3–12) | 10 | (2–19) |
| | 1991–94 | 1.17 | (0.95–1.44) | 1.09 | (0.86–1.38) | 5 | (-2–11) | 3 | (-5–10) |
| | 1996–99 | 1.15 | (0.91–1.46) | 1.14 | (0.88–1.48) | 4 | (-3–11) | 4 | (-4–12) |
| 45–59 years | 1981–84 | 1.14 | (0.76–1.70) | 1.07 | (0.74–1.54) | 5 | (-10–19) | 2 | (-11–15) |
| | 1986–89 | 1.09 | (0.72–1.64) | 1.48 | (1.05–2.08) | 3 | (-11–16) | 15 | (2–28) |
| | 1991–94 | 0.92 | (0.62–1.36) | 1.27 | (0.89–1.83) | -2 | (-12–8) | 7 | (-4–19) |
| | 1996–99 | 1.20 | (0.82–1.76) | 1.47 | (1.02–2.11) | 5 | (-5–15) | 11 | (0–22) |
| 60–77 years | 1981–84 | 1.05 | (0.78–1.41) | 0.81 | (0.56–1.18) | 6 | (-29–40) | -22 | (-61–18) |
| | 1986–89 | 1.19 | (0.90–1.58) | 1.30 | (0.96–1.76) | 19 | (-9–47) | 29 | (-3–62) |
| | 1991–94 | 1.26 | (0.97–1.62) | 1.03 | (0.76–1.39) | 25 | (-1–50) | 3 | (-26–32) |
| | 1996–99 | 1.15 | (0.86–1.54) | 1.08 | (0.78–1.50) | 14 | (-14–42) | 8 | (-24–39) |

**Table 68:** Breast cancer mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Breast: females | | | | | | | |
| 25–77 years | 1981–84 | 44.8 | (38.9–50.7) | 52.0 | (45.1–59.0) | 47.6 | (39.5–55.7) |
| | 1986–89 | 50.8 | (45.1–56.6) | 47.5 | (41.7–53.2) | 47.4 | (39.2–55.6) |
| | 1991–94 | 42.9 | (38.4–47.4) | 49.0 | (42.6–55.3) | 45.3 | (38.8–51.8) |
| | 1996–99 | 47.2 | (42.5–51.9) | 45.9 | (40.2–51.5) | 38.3 | (31.9–44.7) |
| | P (trend) | 0.95 | – | 0.19 | – | 0.11 | – |
| 45–59 years | 1981–84 | 65.6 | (48.4–82.7) | 69.4 | (54.5–84.4) | 62.4 | (51.4–73.3) |
| | 1986–89 | 75.8 | (58.9–92.7) | 60.1 | (48.2–72.1) | 55.0 | (44.2–65.8) |
| | 1991–94 | 64.7 | (51.4–78.0) | 66.0 | (52.5–79.5) | 56.3 | (45.7–66.8) |
| | 1996–99 | 72.9 | (59.6–86.2) | 66.5 | (53.8–79.2) | 54.9 | (45.8–63.9) |
| | P (trend) | 0.66 | – | 0.95 | – | 0.19 | – |
| 60–77 years | 1981–84 | 104 | (88.2–119) | 117 | (93.6–141) | 122 | (89.0–154) |
| | 1986–89 | 110 | (95.7–124) | 109 | (89.5–128) | 126 | (92.6–159) |
| | 1991–94 | 106 | (93.8–119) | 122 | (99.2–144) | 121 | (95.3–147) |
| | 1996–99 | 103 | (90.5–116) | 98.6 | (80.2–117) | 87.4 | (62.0–113) |
| | P (trend) | 0.66 | – | 0.39 | – | 0.19 | – |

**Table 69:** Breast cancer mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Breast: females | | | | | | | | | |
| 25–77 years | 1981–84 | 0.94 | (0.76–1.17) | 1.09 | (0.88–1.36) | -3 | (-13–7) | 4 | (-6–15) |
| | 1986–89 | 1.07 | (0.87–1.32) | 1.00 | (0.81–1.24) | 3 | (-7–13) | 0 | (-10–10) |
| | 1991–94 | 0.95 | (0.79–1.13) | 1.08 | (0.89–1.31) | -2 | (-10–6) | 4 | (-5–13) |
| | 1996–99 | 1.23 | (1.01–1.50) | 1.20 | (0.97–1.47) | 9 | (1–17) | 8 | (-1–16) |
| 45–59 years | 1981–84 | 1.05 | (0.77–1.44) | 1.11 | (0.84–1.47) | 3 | (-17–24) | 7 | (-12–26) |
| | 1986–89 | 1.38 | (1.02–1.85) | 1.09 | (0.83–1.45) | 21 | (1–41) | 5 | (-11–21) |
| | 1991–94 | 1.15 | (0.87–1.52) | 1.17 | (0.89–1.55) | 8 | (-9–25) | 10 | (-7–27) |
| | 1996–99 | 1.33 | (1.04–1.70) | 1.21 | (0.94–1.56) | 18 | (2–34) | 12 | (-4–27) |
| 60–77 years | 1981–84 | 0.85 | (0.63–1.16) | 0.97 | (0.69–1.35) | -18 | (-54–18) | -4 | (-44–36) |
| | 1986–89 | 0.88 | (0.65–1.17) | 0.87 | (0.63–1.19) | -16 | (-52–20) | -17 | (-55–22) |
| | 1991–94 | 0.88 | (0.69–1.12) | 1.01 | (0.76–1.33) | -15 | (-43–14) | 1 | (-34–35) |
| | 1996–99 | 1.18 | (0.86–1.61) | 1.13 | (0.80–1.59) | 16 | (-13–44) | 11 | (-20–43) |

**Table 70:** Prostate cancer mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Prostate: males | | | | | | | |
| 25–77 years | 1981–84 | 24.3 | (20.1–28.5) | 15.4 | (10.6–20.3) | 18.1 | (12.8–23.5) |
| | 1986–89 | 24.3 | (20.7–27.9) | 22.6 | (18.3–26.9) | 25.1 | (18.2–32.0) |
| | 1991–94 | 28.0 | (24.5–31.6) | 26.5 | (21.4–31.6) | 20.9 | (14.9–26.9) |
| | 1996–99 | 24.3 | (21.2–27.4) | 23.3 | (18.9–27.7) | 20.7 | (15.7–25.6) |
| | P (trend) | 0.86 | – | 0.26 | – | 0.73 | – |

**Table 71:** Prostate cancer mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Prostate: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.34 | (0.95–1.88) | 0.85 | (0.55–1.31) | 6 | (-1–13) | -3 | (-10–5) |
| | 1986–89 | 0.97 | (0.71–1.32) | 0.90 | (0.65–1.26) | -1 | (-9–7) | -3 | (-11–6) |
| | 1991–94 | 1.34 | (0.98–1.83) | 1.27 | (0.90–1.79) | 7 | (0–14) | 6 | (-2–14) |
| | 1996–99 | 1.17 | (0.90–1.54) | 1.13 | (0.83–1.53) | 4 | (-2–9) | 3 | (-4–9) |

**Table 72:** Non-lung cancer mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Non-lung: males | | | | | | | |
| 25–77 years | 1981–84 | 213 | (199–226) | 187 | (172–202) | 175 | (160–190) |
| | 1986–89 | 214 | (202–226) | 197 | (185–209) | 181 | (165–196) |
| | 1991–94 | 223 | (212–234) | 203 | (190–217) | 175 | (160–189) |
| | 1996–99 | 221 | (210–232) | 188 | (176–200) | 163 | (150–175) |
| | P (trend) | 0.16 | – | 1.00 | – | 0.16 | – |
| 45–59 years | 1981–84 | 187 | (155–219) | 148 | (127–169) | 166 | (145–186) |
| | 1986–89 | 190 | (160–220) | 159 | (139–179) | 143 | (126–159) |
| | 1991–94 | 176 | (151–201) | 169 | (147–191) | 137 | (121–153) |
| | 1996–99 | 170 | (147–193) | 132 | (113–150) | 128 | (114–141) |
| | P (trend) | 0.07 | – | 0.58 | – | 0.02 | – |
| 60–77 years | 1981–84 | 711 | (664–758) | 646 | (580–712) | 580 | (514–646) |
| | 1986–89 | 721 | (679–763) | 705 | (654–755) | 635 | (564–706) |
| | 1991–94 | 784 | (745–822) | 716 | (660–772) | 613 | (549–678) |
| | 1996–99 | 789 | (750–829) | 702 | (648–755) | 582 | (525–640) |
| | P (trend) | 0.07 | – | 0.34 | – | 0.88 | – |
| Non-lung: females | | | | | | | |
| 25–77 years | 1981–84 | 195 | (183–207) | 191 | (176–207) | 178 | (162–194) |
| | 1986–89 | 193 | (183–204) | 196 | (184–208) | 168 | (152–184) |
| | 1991–94 | 191 | (182–200) | 184 | (172–197) | 164 | (151–177) |
| | 1996–99 | 196 | (187–205) | 181 | (169–192) | 151 | (137–164) |
| | P (trend) | 0.88 | – | 0.16 | – | 0.02 | – |
| 45–59 years | 1981–84 | 211 | (181–240) | 219 | (192–246) | 178 | (158–199) |
| | 1986–89 | 211 | (183–238) | 200 | (178–222) | 160 | (142–178) |
| | 1991–94 | 200 | (177–223) | 206 | (182–230) | 164 | (146–181) |
| | 1996–99 | 200 | (178–222) | 195 | (173–217) | 155 | (140–170) |
| | P (trend) | 0.07 | – | 0.16 | – | 0.07 | – |
| 60–77 years | 1981–84 | 544 | (509–578) | 512 | (455–569) | 501 | (438–564) |
| | 1986–89 | 536 | (504–567) | 562 | (517–607) | 510 | (443–577) |
| | 1991–94 | 569 | (540–598) | 518 | (471–565) | 492 | (439–546) |
| | 1996–99 | 574 | (545–604) | 502 | (459–545) | 446 | (390–503) |
| | P (trend) | 0.07 | – | 0.50 | – | 0.16 | – |

**Table 73:** Non-lung cancer mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Non-lung: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.21 | (1.09–1.35) | 1.07 | (0.95–1.20) | 37 | (17–58) | 12 | (-9–33) |
| | 1986–89 | 1.19 | (1.07–1.32) | 1.09 | (0.98–1.21) | 34 | (14–54) | 16 | (-4–36) |
| | 1991–94 | 1.28 | (1.16–1.41) | 1.16 | (1.05–1.29) | 49 | (31–67) | 29 | (9–48) |
| | 1996–99 | 1.36 | (1.24–1.49) | 1.16 | (1.04–1.28) | 58 | (42–75) | 25 | (8–43) |
| 45–59 years | 1981–84 | 1.13 | (0.91–1.39) | 0.90 | (0.74–1.08) | 21 | (-17–59) | -17 | (-46–12) |
| | 1986–89 | 1.33 | (1.09–1.62) | 1.12 | (0.94–1.32) | 47 | (13–82) | 17 | (-10–43) |
| | 1991–94 | 1.28 | (1.07–1.54) | 1.23 | (1.04–1.47) | 39 | (9–68) | 32 | (5–59) |
| | 1996–99 | 1.33 | (1.12–1.58) | 1.03 | (0.87–1.23) | 42 | (16–69) | 4 | (-19–27) |
| 60–77 years | 1981–84 | 1.23 | (1.08–1.40) | 1.11 | (0.96–1.30) | 131 | (50–212) | 66 | (-27–159) |
| | 1986–89 | 1.13 | (1.00–1.29) | 1.11 | (0.97–1.27) | 86 | (3–168) | 69 | (-18–157) |
| | 1991–94 | 1.28 | (1.14–1.44) | 1.17 | (1.02–1.33) | 171 | (95–246) | 103 | (17–188) |
| | 1996–99 | 1.36 | (1.21–1.51) | 1.20 | (1.06–1.36) | 207 | (137–277) | 119 | (41–198) |
| Non-lung: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.10 | (0.98–1.22) | 1.07 | (0.95–1.21) | 17 | (-3–37) | 13 | (-9–35) |
| | 1986–89 | 1.15 | (1.03–1.28) | 1.17 | (1.04–1.31) | 25 | (6–45) | 28 | (8–48) |
| | 1991–94 | 1.16 | (1.06–1.28) | 1.12 | (1.01–1.25) | 27 | (11–43) | 20 | (2–38) |
| | 1996–99 | 1.30 | (1.17–1.44) | 1.20 | (1.07–1.34) | 45 | (29–61) | 30 | (12–48) |
| 45–59 years | 1981–84 | 1.18 | (0.98–1.42) | 1.23 | (1.04–1.45) | 32 | (-4–68) | 41 | (7–75) |
| | 1986–89 | 1.32 | (1.11–1.56) | 1.25 | (1.07–1.47) | 51 | (18–84) | 40 | (12–69) |
| | 1991–94 | 1.22 | (1.04–1.43) | 1.26 | (1.08–1.47) | 36 | (7–65) | 42 | (13–72) |
| | 1996–99 | 1.29 | (1.12–1.50) | 1.26 | (1.09–1.46) | 45 | (19–72) | 41 | (14–67) |
| 60–77 years | 1981–84 | 1.09 | (0.94–1.25) | 1.02 | (0.86–1.21) | 43 | (-29–115) | 11 | (-74–97) |
| | 1986–89 | 1.05 | (0.91–1.21) | 1.10 | (0.95–1.29) | 26 | (-48–100) | 53 | (-28–133) |
| | 1991–94 | 1.16 | (1.03–1.30) | 1.05 | (0.91–1.21) | 77 | (16–138) | 26 | (-45–97) |
| | 1996–99 | 1.29 | (1.12–1.48) | 1.12 | (0.96–1.31) | 128 | (64–192) | 56 | (-16–127) |

**Table 74:** Unintentional injury mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Injury: males | | | | | | | |
| 25–77 years | 1981–84 | 60.2 | (51.2–69.3) | 53.5 | (44.3–62.6) | 44.6 | (36.9–52.3) |
| | 1986–89 | 56.6 | (48.3–64.8) | 49.7 | (42.7–56.6) | 44.2 | (37.3–51.1) |
| | 1991–94 | 51.2 | (43.5–58.8) | 52.4 | (44.4–60.3) | 27.3 | (22.1–32.4) |
| | 1996–99 | 47.6 | (39.5–55.8) | 35.6 | (29.1–42.1) | 31.9 | (26.6–37.3) |
| | P (trend) | < .01 | – | 0.16 | – | 0.16 | – |
| 25–44 years | 1981–84 | 65.6 | (51.9–79.3) | 49.2 | (37.5–61.0) | 48.9 | (37.1–60.7) |
| | 1986–89 | 65.9 | (53.1–78.6) | 54.1 | (43.5–64.6) | 48.7 | (38.4–58.9) |
| | 1991–94 | 62.9 | (50.4–75.4) | 65.1 | (52.4–77.9) | 25.6 | (19.3–32.0) |
| | 1996–99 | 54.1 | (40.6–67.5) | 44.6 | (33.9–55.3) | 37.5 | (29.5–45.6) |
| | P (trend) | 0.06 | – | 0.86 | – | 0.46 | – |
| 45–59 years | 1981–84 | 44.0 | (27.6–60.5) | 57.0 | (41.9–72.0) | 33.8 | (23.1–44.5) |
| | 1986–89 | 39.3 | (24.3–54.3) | 43.4 | (32.0–54.8) | 44.9 | (33.8–56.0) |
| | 1991–94 | 32.5 | (20.7–44.3) | 34.0 | (23.3–44.7) | 21.8 | (15.1–28.4) |
| | 1996–99 | 39.9 | (27.7–52.0) | 27.7 | (18.5–36.8) | 18.9 | (13.7–24.2) |
| | P (trend) | 0.62 | – | < .01 | – | 0.16 | – |
| 60–77 years | 1981–84 | 66.6 | (50.9–82.2) | 60.2 | (34.2–86.3) | 46.9 | (30.2–63.6) |
| | 1986–89 | 53.8 | (41.0–66.6) | 46.0 | (32.3–59.8) | 31.5 | (16.9–46.1) |
| | 1991–94 | 43.8 | (33.9–53.8) | 41.9 | (27.4–56.4) | 38.4 | (21.4–55.3) |
| | 1996–99 | 40.7 | (31.6–49.8) | 22.1 | (12.5–31.8) | 33.6 | (20.0–47.2) |
| | P (trend) | < .01 | – | < .01 | – | 0.37 | – |
| Injury: females | | | | | | | |
| 25–77 years | 1981–84 | 21.3 | (16.8–25.9) | 20.8 | (15.1–26.5) | 17.9 | (12.6–23.2) |
| | 1986–89 | 16.2 | (12.8–19.6) | 18.4 | (14.5–22.3) | 19.1 | (13.0–25.3) |
| | 1991–94 | 17.1 | (13.7–20.5) | 12.2 | (8.7–15.7) | 12.7 | (8.4–16.9) |
| | 1996–99 | 14.5 | (11.3–17.6) | 10.5 | (7.4–13.6) | 10.4 | (7.1–13.7) |
| | P (trend) | 0.16 | – | < .01 | – | 0.06 | – |
| 25–44 years | 1981–84 | 15.1 | (9.0–21.1) | 11.9 | (5.9–17.9) | 11.4 | (5.8–17.0) |
| | 1986–89 | 11.9 | (7.8–16.1) | 10.2 | (5.7–14.7) | 15.0 | (9.2–20.8) |
| | 1991–94 | 17.6 | (12.5–22.8) | 8.5 | (4.3–12.6) | 10.6 | (5.7–15.5) |
| | 1996–99 | 14.8 | (10.0–19.6) | 6.3 | (2.7–9.8) | 5.7 | (2.6–8.7) |
| | P (trend) | 0.66 | – | < .01 | – | 0.16 | – |
| 45–59 years | 1981–84 | 20.9 | (11.4–30.5) | 13.8 | (6.7–20.9) | 11.7 | (6.2–17.2) |
| | 1986–89 | 15.7 | (7.7–23.7) | 22.3 | (14.5–30.1) | 9.9 | (4.6–15.1) |
| | 1991–94 | 11.6 | (5.3–17.8) | 9.3 | (3.6–15.0) | 7.5 | (3.5–11.5) |
| | 1996–99 | 7.0 | (1.9–12.2) | 9.1 | (3.7–14.6) | 9.2 | (5.3–13.2) |
| | P (trend) | < .01 | – | 0.37 | – | 0.37 | – |
| 60–77 years | 1981–84 | 36.5 | (26.7–46.2) | 49.6 | (30.1–69.1) | 39.8 | (21.2–58.4) |
| | 1986–89 | 26.9 | (19.2–34.5) | 33.4 | (22.3–44.6) | 38.9 | (15.8–62.0) |
| | 1991–94 | 21.7 | (15.7–27.6) | 24.3 | (14.0–34.6) | 23.2 | (8.9–37.5) |
| | 1996–99 | 21.8 | (15.5–28.1) | 22.0 | (12.7–31.4) | 22.8 | (11.0–34.7) |
| | P (trend) | 0.06 | – | 0.06 | – | 0.06 | – |

**Table 75:** Unintentional injury mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Injury: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.35 | (1.07–1.70) | 1.20 | (0.94–1.53) | 16 | (4–28) | 9 | (-3–21) |
| | 1986–89 | 1.28 | (1.03–1.59) | 1.12 | (0.91–1.39) | 12 | (2–23) | 6 | (-4–15) |
| | 1991–94 | 1.88 | (1.47–2.39) | 1.92 | (1.51–2.45) | 24 | (15–33) | 25 | (16–35) |
| | 1996–99 | 1.49 | (1.18–1.89) | 1.12 | (0.87–1.43) | 16 | (6–25) | 4 | (-5–12) |
| 25–44 years | 1981–84 | 1.34 | (0.98–1.85) | 1.01 | (0.72–1.41) | 17 | (-1–35) | 0 | (-16–17) |
| | 1986–89 | 1.35 | (1.02–1.80) | 1.11 | (0.83–1.48) | 17 | (1–34) | 5 | (-9–20) |
| | 1991–94 | 2.45 | (1.79–3.37) | 2.54 | (1.85–3.48) | 37 | (23–51) | 40 | (25–54) |
| | 1996–99 | 1.44 | (1.04–2.00) | 1.19 | (0.86–1.64) | 17 | (1–32) | 7 | (-6–21) |
| 45–59 years | 1981–84 | 1.30 | (0.80–2.13) | 1.68 | (1.11–2.55) | 10 | (-9–30) | 23 | (5–42) |
| | 1986–89 | 0.88 | (0.56–1.38) | 0.97 | (0.67–1.39) | -6 | (-24–13) | -2 | (-17–14) |
| | 1991–94 | 1.49 | (0.93–2.40) | 1.56 | (1.01–2.42) | 11 | (-3–24) | 12 | (-0–25) |
| | 1996–99 | 2.11 | (1.40–3.18) | 1.46 | (0.95–2.25) | 21 | (8–34) | 9 | (-2–19) |
| 60–77 years | 1981–84 | 1.42 | (0.93–2.18) | 1.29 | (0.73–2.25) | 20 | (-3–43) | 13 | (-18–44) |
| | 1986–89 | 1.71 | (1.01–2.88) | 1.46 | (0.84–2.54) | 22 | (3–42) | 15 | (-6–35) |
| | 1991–94 | 1.14 | (0.70–1.88) | 1.09 | (0.62–1.92) | 6 | (-14–25) | 4 | (-19–26) |
| | 1996–99 | 1.21 | (0.76–1.93) | 0.66 | (0.36–1.19) | 7 | (-9–24) | -12 | (-28–5) |
| Injury: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.19 | (0.83–1.72) | 1.17 | (0.78–1.75) | 4 | (-4–10) | 3 | (-5–11) |
| | 1986–89 | 0.85 | (0.58–1.25) | 0.96 | (0.65–1.42) | -3 | (-10–4) | -1 | (-8–7) |
| | 1991–94 | 1.35 | (0.91–1.99) | 0.97 | (0.62–1.50) | 4 | (-1–10) | -0 | (-6–5) |
| | 1996–99 | 1.39 | (0.95–2.04) | 1.01 | (0.66–1.56) | 4 | (-1–9) | 0 | (-4–5) |
| 25–44 years | 1981–84 | 1.32 | (0.70–2.50) | 1.04 | (0.52–2.11) | 4 | (-5–12) | 1 | (-8–9) |
| | 1986–89 | 0.79 | (0.47–1.34) | 0.68 | (0.38–1.22) | -3 | (-10–4) | -5 | (-12–3) |
| | 1991–94 | 1.66 | (0.97–2.87) | 0.80 | (0.41–1.57) | 7 | (0–14) | -2 | (-9–4) |
| | 1996–99 | 2.61 | (1.39–4.91) | 1.11 | (0.51–2.42) | 9 | (4–15) | 1 | (-4–5) |
| 45–59 years | 1981–84 | 1.79 | (0.93–3.45) | 1.18 | (0.59–2.37) | 9 | (-2–20) | 2 | (-7–11) |
| | 1986–89 | 1.59 | (0.76–3.33) | 2.26 | (1.20–4.28) | 6 | (-4–15) | 12 | (3–22) |
| | 1991–94 | 1.55 | (0.73–3.32) | 1.24 | (0.55–2.80) | 4 | (-3–12) | 2 | (-5–9) |
| | 1996–99 | 0.76 | (0.33–1.78) | 0.99 | (0.48–2.06) | -2 | (-9–4) | -0 | (-7–7) |
| 60–77 years | 1981–84 | 0.92 | (0.53–1.57) | 1.25 | (0.68–2.29) | -3 | (-24–18) | 10 | (-17–37) |
| | 1986–89 | 0.69 | (0.36–1.34) | 0.86 | (0.44–1.70) | -12 | (-36–12) | -5 | (-31–20) |
| | 1991–94 | 0.93 | (0.48–1.83) | 1.05 | (0.50–2.21) | -2 | (-17–14) | 1 | (-17–19) |
| | 1996–99 | 0.96 | (0.53–1.73) | 0.97 | (0.49–1.89) | -1 | (-14–12) | -1 | (-16–14) |

**Table 76:** Road traffic crash mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| RTC: males | | | | | | | |
| 25–77 years | 1981–84 | 35.9 | (28.6–43.2) | 27.7 | (20.9–34.5) | 20.5 | (15.1–25.9) |
| | 1986–89 | 33.2 | (26.7–39.7) | 28.5 | (23.1–34.0) | 25.0 | (19.6–30.4) |
| | 1991–94 | 25.4 | (19.7–31.0) | 29.6 | (23.3–35.9) | 16.1 | (11.9–20.3) |
| | 1996–99 | 24.7 | (18.7–30.8) | 21.6 | (16.2–26.9) | 15.9 | (12.2–19.7) |
| | P (trend) | 0.06 | – | 0.27 | – | 0.27 | – |
| 25–44 years | 1981–84 | 44.9 | (33.3–56.4) | 25.6 | (17.3–33.9) | 23.4 | (14.9–31.8) |
| | 1986–89 | 43.9 | (33.5–54.4) | 36.2 | (27.4–45.1) | 27.7 | (19.6–35.8) |
| | 1991–94 | 36.6 | (26.8–46.4) | 39.4 | (28.9–49.9) | 16.5 | (11.6–21.5) |
| | 1996–99 | 31.6 | (21.2–41.9) | 28.5 | (19.4–37.5) | 18.7 | (13.2–24.3) |
| | P (trend) | < .01 | – | 0.74 | – | 0.36 | – |
| 45–59 years | 1981–84 | 25.2 | (12.8–37.6) | 33.5 | (21.9–45.1) | 14.5 | (6.4–22.5) |
| | 1986–89 | 24.8 | (12.9–36.6) | 20.4 | (12.5–28.2) | 25.0 | (16.8–33.3) |
| | 1991–94 | 9.3 | (2.8–15.8) | 19.0 | (10.7–27.4) | 10.7 | (6.3–15.1) |
| | 1996–99 | 16.1 | (8.2–23.9) | 14.4 | (7.6–21.1) | 6.8 | (3.6–10.1) |
| | P (trend) | 0.36 | – | 0.06 | – | 0.15 | – |
| 60–77 years | 1981–84 | 25.9 | (15.9–35.9) | 25.8 | (5.5–46.1) | 20.5 | (10.6–30.4) |
| | 1986–89 | 15.7 | (9.4–22.0) | 18.8 | (9.9–27.6) | 18.0 | (6.3–29.8) |
| | 1991–94 | 16.2 | (10.1–22.3) | 17.1 | (8.3–26.0) | 21.9 | (7.2–36.6) |
| | 1996–99 | 17.7 | (11.6–23.7) | 12.6 | (5.3–19.9) | 20.1 | (9.7–30.4) |
| | P (trend) | 0.57 | – | < .01 | – | 0.89 | – |
| RTC: females | | | | | | | |
| 25–77 years | 1981–84 | 11.5 | (8.1–15.0) | 13.3 | (8.9–17.6) | 10.8 | (6.8–14.8) |
| | 1986–89 | 10.2 | (7.4–12.9) | 11.6 | (8.6–14.5) | 12.9 | (7.8–18.0) |
| | 1991–94 | 11.4 | (8.5–14.3) | 7.9 | (5.0–10.8) | 10.2 | (6.3–14.0) |
| | 1996–99 | 8.6 | (6.0–11.2) | 6.9 | (4.4–9.3) | 8.6 | (5.6–11.6) |
| | P (trend) | 0.27 | – | < .01 | – | 0.15 | – |
| 25–44 years | 1981–84 | 9.5 | (4.6–14.3) | 7.3 | (3.1–11.5) | 7.4 | (2.6–12.2) |
| | 1986–89 | 8.1 | (4.8–11.5) | 7.1 | (3.6–10.6) | 13.3 | (7.9–18.8) |
| | 1991–94 | 13.6 | (8.9–18.3) | 7.2 | (3.2–11.2) | 7.8 | (3.7–11.8) |
| | 1996–99 | 11.2 | (6.9–15.4) | 4.6 | (1.6–7.6) | 4.7 | (1.9–7.6) |
| | P (trend) | 0.36 | – | 0.15 | – | 0.36 | – |
| 45–59 years | 1981–84 | 12.1 | (5.0–19.2) | 10.2 | (4.0–16.4) | 8.8 | (3.9–13.7) |
| | 1986–89 | 11.8 | (4.8–18.8) | 13.3 | (7.1–19.5) | 5.4 | (1.9–8.9) |
| | 1991–94 | 7.4 | (2.5–12.4) | 5.5 | (0.9–10.1) | 5.3 | (1.9–8.7) |
| | 1996–99 | 3.9 | (1.4–10.8) | 6.4 | (2.0–10.9) | 6.7 | (3.6–9.8) |
| | P (trend) | < .01 | – | 0.27 | – | 0.74 | – |
| 60–77 years | 1981–84 | 15.8 | (9.1–22.5) | 30.6 | (15.3–45.8) | 20.9 | (8.0–33.7) |
| | 1986–89 | 13.2 | (7.9–18.5) | 20.2 | (12.4–28.0) | 20.2 | (1.9–38.5) |
| | 1991–94 | 10.6 | (6.6–14.7) | 12.4 | (5.1–19.7) | 21.0 | (7.4–34.7) |
| | 1996–99 | 7.6 | (3.7–11.4) | 12.7 | (6.0–19.4) | 19.7 | (8.7–30.8) |
| | P (trend) | < .01 | – | 0.06 | – | 0.27 | – |

**Table 77:** Road traffic crash mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| RTC: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.75 | (1.26–2.44) | 1.35 | (0.94–1.94) | 15 | (6–25) | 7 | (-2–16) |
| | 1986–89 | 1.33 | (0.99–1.77) | 1.14 | (0.85–1.52) | 8 | (-0–17) | 4 | (-4–11) |
| | 1991–94 | 1.57 | (1.12–2.22) | 1.83 | (1.31–2.57) | 9 | (2–16) | 13 | (6–21) |
| | 1996–99 | 1.55 | (1.10–2.18) | 1.35 | (0.96–1.91) | 9 | (2–16) | 6 | (-1–12) |
| 25–44 years | 1981–84 | 1.92 | (1.23–3.00) | 1.10 | (0.67–1.78) | 22 | (7–36) | 2 | (-10–14) |
| | 1986–89 | 1.58 | (1.09–2.31) | 1.31 | (0.89–1.91) | 16 | (3–29) | 9 | (-4–21) |
| | 1991–94 | 2.22 | (1.48–3.31) | 2.39 | (1.60–3.56) | 20 | (9–31) | 23 | (11–35) |
| | 1996–99 | 1.68 | (1.08–2.62) | 1.52 | (0.98–2.34) | 13 | (1–25) | 10 | (-1–20) |
| 45–59 years | 1981–84 | 1.74 | (0.83–3.66) | 2.32 | (1.20–4.46) | 11 | (-4–26) | 19 | (5–33) |
| | 1986–89 | 0.99 | (0.55–1.77) | 0.81 | (0.49–1.35) | -0 | (-15–14) | -5 | (-16–7) |
| | 1991–94 | 0.87 | (0.38–1.96) | 1.78 | (0.97–3.25) | -1 | (-9–6) | 8 | (-1–18) |
| | 1996–99 | 2.36 | (1.19–4.67) | 2.11 | (1.08–4.11) | 9 | (1–18) | 8 | (0–15) |
| 60–77 years | 1981–84 | 1.26 | (0.68–2.34) | 1.26 | (0.50–3.16) | 5 | (-9–19) | 5 | (-17–28) |
| | 1986–89 | 0.87 | (0.41–1.87) | 1.04 | (0.47–2.32) | -2 | (-16–11) | 1 | (-14–15) |
| | 1991–94 | 0.74 | (0.34–1.60) | 0.78 | (0.33–1.83) | -6 | (-22–10) | -5 | (-22–12) |
| | 1996–99 | 0.88 | (0.47–1.63) | 0.63 | (0.29–1.36) | -2 | (-14–10) | -8 | (-20–5) |
| RTC: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.07 | (0.66–1.73) | 1.23 | (0.75–2.03) | 1 | (-5–6) | 3 | (-4–8) |
| | 1986–89 | 0.79 | (0.49–1.27) | 0.89 | (0.56–1.43) | -3 | (-9–3) | -1 | (-7–5) |
| | 1991–94 | 1.12 | (0.71–1.77) | 0.78 | (0.46–1.32) | 1 | (-4–6) | -2 | (-7–3) |
| | 1996–99 | 1.00 | | 0.80 | (0.49–1.32) | 0 | | -2 | (-6–2) |
| 25–44 years | 1981–84 | 1.28 | (0.56–2.91) | 0.99 | (0.42–2.35) | 2 | (-5–9) | -0 | (-6–6) |
| | 1986–89 | 0.61 | (0.34–1.09) | 0.53 | (0.28–1.02) | -5 | (-12–1) | -6 | (-13–0) |
| | 1991–94 | 1.75 | (0.94–3.26) | 0.92 | (0.43–1.98) | 6 | (-0–12) | -1 | (-6–5) |
| | 1996–99 | 2.36 | (1.15–4.83) | 0.97 | (0.40–2.37) | 6 | (1–12) | -0 | (-4–4) |
| 45–59 years | 1981–84 | 1.37 | (0.61–3.08) | 1.16 | (0.51–2.65) | 3 | (-5–12) | 1 | (-7–9) |
| | 1986–89 | 2.20 | (0.91–5.31) | 2.47 | (1.11–5.53) | 6 | (-1–14) | 8 | (1–15) |
| | 1991–94 | 1.39 | (0.55–3.51) | 1.03 | (0.36–2.95) | 2 | (-4–8) | 0 | (-6–6) |
| | 1996–99 | 0.58 | (0.19–1.79) | 0.96 | (0.42–2.23) | -3 | (-8–2) | -0 | (-6–5) |
| 60–77 years | 1981–84 | 0.76 | (0.36–1.60) | 1.47 | (0.66–3.24) | -5 | (-20–9) | 10 | (-10–30) |
| | 1986–89 | 0.65 | (0.24–1.75) | 1.00 | | -7 | (-26–12) | 0 | |
| | 1991–94 | 0.51 | (0.24–1.07) | 0.59 | (0.25–1.41) | -10 | (-25–4) | -9 | (-24–7) |
| | 1996–99 | 0.38 | (0.18–0.82) | 0.64 | (0.30–1.39) | -12 | (-24–-0) | -7 | (-20–6) |

**Table 78:** Non-road traffic crash mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Non-RTC: males | | | | | | | |
| 25–77 years | 1981–84 | 24.3 | (18.9–29.8) | 25.8 | (19.6–32.0) | 24.1 | (18.6–29.6) |
| | 1986–89 | 23.4 | (18.2–28.5) | 21.1 | (16.8–25.5) | 19.1 | (14.8–23.4) |
| | 1991–94 | 25.8 | (20.6–30.9) | 22.8 | (17.9–27.7) | 11.1 | (8.0–14.2) |
| | 1996–99 | 22.9 | (17.5–28.4) | 14.1 | (10.4–17.8) | 16.0 | (12.2–19.8) |
| | P (trend) | 0.85 | – | 0.06 | – | 0.37 | – |
| 25–44 years | 1981–84 | 20.7 | (13.3–28.2) | 23.6 | (15.3–32.0) | 25.5 | (17.3–33.7) |
| | 1986–89 | 21.9 | (14.6–29.3) | 17.8 | (12.0–23.6) | 20.9 | (14.7–27.2) |
| | 1991–94 | 26.3 | (18.5–34.1) | 25.8 | (18.5–33.0) | 9.1 | (5.1–13.1) |
| | 1996–99 | 22.5 | (13.8–31.2) | 16.2 | (10.4–21.9) | 18.8 | (12.9–24.6) |
| | P (trend) | 0.37 | – | 0.59 | – | 0.54 | – |
| 45–59 years | 1981–84 | 18.8 | (8.0–29.6) | 23.5 | (13.6–33.3) | 19.4 | (12.1–26.6) |
| | 1986–89 | 14.5 | (5.3–23.7) | 23.0 | (14.7–31.3) | 19.8 | (12.3–27.4) |
| | 1991–94 | 23.2 | (13.4–33.0) | 15.0 | (8.2–21.7) | 11.1 | (6.1–16.0) |
| | 1996–99 | 23.8 | (14.5–33.1) | 13.3 | (7.1–19.5) | 12.1 | (8.0–16.2) |
| | P (trend) | 0.27 | – | 0.06 | – | 0.16 | – |
| 60–77 years | 1981–84 | 40.7 | (28.6–52.7) | 34.4 | (18.0–50.8) | 26.3 | (12.9–39.8) |
| | 1986–89 | 38.1 | (27.0–49.3) | 27.3 | (16.7–37.8) | 13.5 | (4.7–22.2) |
| | 1991–94 | 27.7 | (19.8–35.6) | 24.8 | (13.3–36.4) | 16.4 | (7.7–25.2) |
| | 1996–99 | 23.0 | (16.2–29.8) | 9.5 | (3.2–15.8) | 13.5 | (4.6–22.4) |
| | P (trend) | 0.02 | – | 0.02 | – | 0.37 | – |
| Non-RTC: females | | | | | | | |
| 25–77 years | 1981–84 | 9.8 | (6.8–12.8) | 7.6 | (3.9–11.2) | 7.1 | (3.6–10.6) |
| | 1986–89 | 6.1 | (4.0–8.2) | 6.9 | (4.3–9.4) | 6.2 | (2.7–9.7) |
| | 1991–94 | 5.6 | (3.9–7.4) | 4.3 | (2.4–6.2) | 2.5 | (0.7–4.3) |
| | 1996–99 | 5.9 | (4.1–7.7) | 3.6 | (1.7–5.6) | 1.8 | (0.5–3.1) |
| | P (trend) | 0.27 | – | 0.02 | – | 0.06 | – |
| 25–44 years | 1981–84 | 5.6 | (1.9–9.3) | 4.6 | (0.3–8.8) | 4.0 | (1.0–7.0) |
| | 1986–89 | 3.8 | (1.2–6.4) | 3.1 | (0.4–5.9) | 1.7 | (0.6–5.3) |
| | 1991–94 | 4.0 | (1.9–6.2) | 1.3 | (0.2–2.4) | 2.8 | (0.0–5.6) |
| | 1996–99 | 3.6 | (1.4–5.8) | 1.6 | (0.5–5.1) | 0.9 | (0.3–2.9) |
| | P (trend) | 0.16 | – | 0.27 | – | 0.16 | – |
| 45–59 years | 1981–84 | 8.9 | (2.5–15.3) | 3.6 | (0.1–7.1) | 2.9 | (0.3–5.5) |
| | 1986–89 | 3.9 | (1.4–10.6) | 9.0 | (4.3–13.8) | 4.5 | (0.6–8.4) |
| | 1991–94 | 4.1 | (0.3–8.0) | 3.8 | (0.5–7.1) | 2.1 | (0.8–5.9) |
| | 1996–99 | 3.1 | (1.1–9.1) | 2.7 | (0.9–8.5) | 2.6 | (0.1–5.0) |
| | P (trend) | 0.16 | – | 0.59 | – | 0.59 | – |
| 60–77 years | 1981–84 | 20.7 | (13.5–27.8) | 19.0 | (6.8–31.2) | 19.0 | (5.4–32.5) |
| | 1986–89 | 13.7 | (8.2–19.2) | 13.3 | (5.4–21.2) | 18.7 | (4.4–32.9) |
| | 1991–94 | 11.0 | (6.7–15.4) | 11.9 | (4.5–19.2) | 2.2 | (0.3–15.3) |
| | 1996–99 | 14.2 | (9.2–19.2) | 9.3 | (2.8–15.8) | 3.1 | (0.8–12.4) |
| | P (trend) | 0.37 | – | 0.02 | – | 0.27 | – |

**Table 79:** Non-road traffic crash mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Non-RTC: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.01 | (0.73–1.39) | 1.07 | (0.77–1.49) | 0 | (-8–8) | 2 | (-7–10) |
| | 1986–89 | 1.22 | (0.89–1.67) | 1.10 | (0.81–1.50) | 4 | (-2–11) | 2 | (-4–8) |
| | 1991–94 | 2.32 | (1.65–3.26) | 2.05 | (1.44–2.91) | 15 | (9–21) | 12 | (6–17) |
| | 1996–99 | 1.43 | (1.03–2.01) | 0.88 | (0.62–1.25) | 7 | (0–14) | -2 | (-7–3) |
| 25–44 years | 1981–84 | 0.81 | (0.50–1.31) | 0.92 | (0.57–1.49) | -5 | (-16–6) | -2 | (-14–10) |
| | 1986–89 | 1.05 | (0.67–1.64) | 0.85 | (0.55–1.33) | 1 | (-9–11) | -3 | (-12–5) |
| | 1991–94 | 2.88 | (1.70–4.90) | 2.82 | (1.68–4.76) | 17 | (8–26) | 17 | (8–25) |
| | 1996–99 | 1.20 | (0.73–1.97) | 0.86 | (0.54–1.38) | 4 | (-7–14) | -3 | (-11–6) |
| 45–59 years | 1981–84 | 0.97 | (0.49–1.93) | 1.21 | (0.69–2.13) | -1 | (-14–13) | 4 | (-8–16) |
| | 1986–89 | 0.73 | (0.35–1.53) | 1.16 | (0.69–1.96) | -5 | (-17–7) | 3 | (-8–14) |
| | 1991–94 | 2.10 | (1.13–3.89) | 1.35 | (0.72–2.55) | 12 | (1–23) | 4 | (-5–12) |
| | 1996–99 | 1.97 | (1.17–3.30) | 1.10 | (0.62–1.96) | 12 | (2–22) | 1 | (-6–9) |
| 60–77 years | 1981–84 | 1.55 | (0.86–2.79) | 1.31 | (0.65–2.63) | 14 | (-4–32) | 8 | (-13–29) |
| | 1986–89 | 2.83 | (1.39–5.78) | 2.02 | (0.95–4.32) | 25 | (11–39) | 14 | (0–28) |
| | 1991–94 | 1.68 | (0.92–3.08) | 1.51 | (0.74–3.06) | 11 | (-1–23) | 8 | (-6–23) |
| | 1996–99 | 1.70 | (0.83–3.50) | 0.70 | (0.28–1.79) | 10 | (-2–21) | -4 | (-15–7) |
| Non-RTC: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.38 | (0.77–2.46) | 1.07 | (0.54–2.13) | 3 | (-2–7) | 1 | (-5–6) |
| | 1986–89 | 0.98 | (0.50–1.89) | 1.10 | (0.56–2.17) | -0 | (-4–4) | 1 | (-4–5) |
| | 1991–94 | 2.25 | (1.02–5.00) | 1.72 | (0.73–4.06) | 3 | (1–6) | 2 | (-1–5) |
| | 1996–99 | 3.25 | (1.52–6.97) | 2.01 | (0.84–4.82) | 4 | (2–6) | 2 | (-1–4) |
| 25–44 years | 1981–84 | 1.40 | (0.52–3.79) | 1.14 | (0.35–3.78) | 2 | (-3–6) | 1 | (-5–6) |
| | 1986–89 | 2.24 | (0.60–8.38) | 1.83 | (0.44–7.65) | 2 | (-1–5) | 1 | (-2–5) |
| | 1991–94 | 1.43 | (0.47–4.39) | 0.46 | (0.12–1.72) | 1 | (-2–5) | -2 | (-5–2) |
| | 1996–99 | 3.93 | (1.07–14.4) | 1.79 | (0.36–9.00) | 3 | (0–5) | 1 | (-1–3) |
| 45–59 years | 1981–84 | 3.04 | (0.97–9.51) | 1.24 | (0.33–4.61) | 6 | (-1–13) | 1 | (-4–5) |
| | 1986–89 | 0.87 | (0.23–3.27) | 2.01 | (0.73–5.55) | -1 | (-6–5) | 5 | (-2–11) |
| | 1991–94 | 1.94 | (0.49–7.69) | 1.78 | (0.46–6.86) | 2 | (-2–6) | 2 | (-2–6) |
| | 1996–99 | 1.23 | (0.30–5.11) | 1.06 | (0.24–4.66) | 1 | (-4–5) | 0 | (-4–4) |
| 60–77 years | 1981–84 | 1.09 | (0.49–2.41) | 1.00 | (0.38–2.62) | 2 | (-14–17) | 0 | (-18–18) |
| | 1986–89 | 0.73 | (0.31–1.74) | 0.71 | (0.27–1.87) | -5 | (-20–10) | -5 | (-22–11) |
| | 1991–94 | 5.11 | (0.69–37.8) | 5.52 | (0.71–43.1) | 9 | (3–15) | 10 | (1–18) |
| | 1996–99 | 4.59 | (1.10–19.2) | 3.01 | (0.64–14.2) | 11 | (5–18) | 6 | (-2–14) |

**Table 80:** Suicide mortality rates per 100,000, by income

| | | Low income | | Medium income | | High income | |
|---|---|---|---|---|---|---|---|
| Suicide: males | | | | | | | |
| 25–77 years | 1981–84 | 27.3 | (21.2–33.5) | 20.7 | (15.5–25.9) | 21.5 | (16.6–26.4) |
| | 1986–89 | 34.0 | (27.5–40.6) | 26.9 | (21.7–32.2) | 24.7 | (19.7–29.7) |
| | 1991–94 | 41.2 | (34.3–48.1) | 27.2 | (21.7–32.7) | 24.1 | (19.2–29.0) |
| | 1996–99 | 41.1 | (33.8–48.4) | 32.8 | (26.4–39.1) | 25.1 | (20.7–29.6) |
| | P (trend) | 0.05 | – | 0.05 | – | 0.15 | – |
| 25–44 years | 1981–84 | 22.2 | (14.0–30.5) | 20.3 | (13.1–27.6) | 20.7 | (13.8–27.5) |
| | 1986–89 | 26.6 | (18.0–35.2) | 27.9 | (19.9–36.0) | 20.2 | (14.3–26.1) |
| | 1991–94 | 46.9 | (36.1–57.6) | 28.2 | (20.0–36.5) | 27.2 | (20.0–34.4) |
| | 1996–99 | 49.8 | (37.7–62.0) | 39.1 | (28.8–49.4) | 29.6 | (22.9–36.3) |
| | P (trend) | 0.05 | – | 0.05 | – | 0.05 | – |
| 45–59 years | 1981–84 | 29.1 | (15.0–43.2) | 18.3 | (9.6–27.0) | 15.7 | (9.5–21.9) |
| | 1986–89 | 40.7 | (25.1–56.3) | 32.0 | (22.3–41.7) | 23.8 | (16.8–30.7) |
| | 1991–94 | 40.1 | (27.0–53.2) | 21.9 | (13.6–30.1) | 20.9 | (14.0–27.8) |
| | 1996–99 | 29.6 | (19.2–39.9) | 24.7 | (16.4–33.0) | 17.6 | (12.4–22.8) |
| | P (trend) | 0.87 | – | 0.71 | – | 0.87 | – |
| 60–77 years | 1981–84 | 38.4 | (27.4–49.4) | 24.6 | (12.2–37.1) | 30.7 | (16.9–44.4) |
| | 1986–89 | 45.1 | (33.8–56.5) | 17.9 | (9.9–25.9) | 37.5 | (20.6–54.4) |
| | 1991–94 | 28.0 | (20.1–36.0) | 31.1 | (19.0–43.1) | 20.1 | (8.4–31.9) |
| | 1996–99 | 32.9 | (24.2–41.5) | 26.3 | (15.5–37.1) | 22.9 | (12.0–33.7) |
| | P (trend) | 0.38 | – | 0.51 | – | 0.26 | – |
| Suicide: females | | | | | | | |
| 25–77 years | 1981–84 | 9.6 | (6.7–12.6) | 6.9 | (4.3–9.5) | 11.6 | (7.9–15.4) |
| | 1986–89 | 10.0 | (7.2–12.9) | 10.5 | (7.4–13.7) | 7.4 | (4.5–10.3) |
| | 1991–94 | 9.6 | (6.9–12.4) | 8.3 | (5.3–11.2) | 6.7 | (4.5–8.9) |
| | 1996–99 | 11.5 | (8.6–14.4) | 6.2 | (3.7–8.8) | 5.8 | (3.8–7.9) |
| | P (trend) | 0.26 | – | 0.71 | – | 0.05 | – |
| 25–44 years | 1981–84 | 5.8 | (2.4–9.2) | 5.7 | (2.2–9.1) | 10.4 | (4.6–16.1) |
| | 1986–89 | 8.8 | (4.8–12.7) | 9.1 | (4.7–13.5) | 7.8 | (3.4–12.1) |
| | 1991–94 | 7.9 | (4.1–11.6) | 7.5 | (3.5–11.5) | 5.7 | (3.1–8.4) |
| | 1996–99 | 15.0 | (10.2–19.8) | 6.2 | (2.3–10.2) | 7.1 | (4.0–10.2) |
| | P (trend) | 0.15 | – | 0.87 | – | 0.38 | – |
| 45–59 years | 1981–84 | 15.2 | (7.1–23.2) | 6.3 | (1.9–10.7) | 13.9 | (8.2–19.6) |
| | 1986–89 | 13.6 | (6.9–20.4) | 10.3 | (5.2–15.4) | 5.5 | (2.2–8.7) |
| | 1991–94 | 16.3 | (9.1–23.5) | 7.0 | (2.4–11.6) | 5.9 | (2.6–9.1) |
| | 1996–99 | 9.1 | (4.1–14.2) | 7.1 | (2.7–11.5) | 5.4 | (2.7–8.0) |
| | P (trend) | 0.26 | – | 0.99 | – | 0.38 | – |
| 60–77 years | 1981–84 | 12.6 | (7.2–17.9) | 10.3 | (3.5–17.0) | 12.2 | (4.8–19.5) |
| | 1986–89 | 9.1 | (4.8–13.3) | 14.1 | (6.3–21.9) | 8.7 | (1.8–15.6) |
| | 1991–94 | 6.6 | (3.4–9.8) | 11.5 | (3.9–19.1) | 9.9 | (3.2–16.7) |
| | 1996–99 | 5.9 | (2.9–8.8) | 5.2 | (1.0–9.4) | 3.4 | (0.8–13.6) |
| | P (trend) | 0.05 | – | 0.15 | – | 0.05 | – |

**Table 81:** Suicide mortality rate ratios and rate differences, by income

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Low income | | Medium income | | Low income | | Medium income | |
| Suicide: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.27 | (0.92–1.76) | 0.96 | (0.69–1.35) | 6 | (-2–14) | -1 | (-8–6) |
| | 1986–89 | 1.38 | (1.04–1.82) | 1.09 | (0.82–1.45) | 9 | (1–18) | 2 | (-5–10) |
| | 1991–94 | 1.71 | (1.31–2.22) | 1.13 | (0.85–1.50) | 17 | (9–26) | 3 | (-4–10) |
| | 1996–99 | 1.64 | (1.28–2.10) | 1.30 | (1.00–1.69) | 16 | (8–25) | 8 | (-0–15) |
| 25–44 years | 1981–84 | 1.08 | (0.65–1.77) | 0.98 | (0.60–1.60) | 2 | (-9–12) | -0 | (-10–10) |
| | 1986–89 | 1.31 | (0.85–2.03) | 1.38 | (0.92–2.08) | 6 | (-4–17) | 8 | (-2–18) |
| | 1991–94 | 1.72 | (1.21–2.44) | 1.04 | (0.70–1.54) | 20 | (7–33) | 1 | (-10–12) |
| | 1996–99 | 1.68 | (1.21–2.35) | 1.32 | (0.93–1.87) | 20 | (6–34) | 10 | (-3–22) |
| 45–59 years | 1981–84 | 1.85 | (0.99–3.46) | 1.16 | (0.63–2.16) | 13 | (-2–29) | 3 | (-8–13) |
| | 1986–89 | 1.71 | (1.06–2.77) | 1.35 | (0.88–2.06) | 17 | (-0–34) | 8 | (-4–20) |
| | 1991–94 | 1.92 | (1.21–3.06) | 1.05 | (0.63–1.73) | 19 | (4–34) | 1 | (-10–12) |
| | 1996–99 | 1.68 | (1.06–2.65) | 1.40 | (0.90–2.20) | 12 | (0–24) | 7 | (-3–17) |
| 60–77 years | 1981–84 | 1.25 | (0.74–2.13) | 0.80 | (0.41–1.58) | 8 | (-10–25) | -6 | (-25–13) |
| | 1986–89 | 1.20 | (0.72–2.02) | 0.48 | (0.25–0.90) | 8 | (-13–28) | -20 | (-38–-1) |
| | 1991–94 | 1.39 | (0.73–2.66) | 1.54 | (0.77–3.11) | 8 | (-6–22) | 11 | (-6–28) |
| | 1996–99 | 1.44 | (0.84–2.48) | 1.15 | (0.61–2.16) | 10 | (-4–24) | 3 | (-12–19) |
| Suicide: females | | | | | | | | | |
| 25–77 years | 1981–84 | 0.83 | (0.53–1.29) | 0.59 | (0.36–0.97) | -2 | (-7–3) | -5 | (-9–-0) |
| | 1986–89 | 1.35 | (0.83–2.19) | 1.42 | (0.86–2.32) | 3 | (-2–7) | 3 | (-1–7) |
| | 1991–94 | 1.44 | (0.93–2.23) | 1.23 | (0.76–2.00) | 3 | (-1–7) | 2 | (-2–5) |
| | 1996–99 | 1.97 | (1.27–3.04) | 1.06 | (0.62–1.82) | 6 | (2–9) | 0 | (-3–4) |
| 25–44 years | 1981–84 | 0.56 | (0.25–1.25) | 0.55 | (0.24–1.24) | -5 | (-11–2) | -5 | (-11–2) |
| | 1986–89 | 1.13 | (0.55–2.32) | 1.17 | (0.56–2.46) | 1 | (-5–7) | 1 | (-5–8) |
| | 1991–94 | 1.37 | (0.71–2.67) | 1.31 | (0.64–2.66) | 2 | (-2–7) | 2 | (-3–7) |
| | 1996–99 | 2.10 | (1.22–3.61) | 0.88 | (0.41–1.88) | 8 | (2–14) | -1 | (-6–4) |
| 45–59 years | 1981–84 | 1.09 | (0.56–2.14) | 0.45 | (0.20–1.02) | 1 | (-9–11) | -8 | (-15–-0) |
| | 1986–89 | 2.48 | (1.15–5.37) | 1.88 | (0.87–4.05) | 8 | (1–16) | 5 | (-1–11) |
| | 1991–94 | 2.78 | (1.37–5.63) | 1.20 | (0.51–2.81) | 11 | (3–18) | 1 | (-5–7) |
| | 1996–99 | 1.71 | (0.82–3.58) | 1.33 | (0.60–2.93) | 4 | (-2–10) | 2 | (-3–7) |
| 60–77 years | 1981–84 | 1.03 | (0.49–2.17) | 0.84 | (0.34–2.07) | 0 | (-9–10) | -2 | (-12–8) |
| | 1986–89 | 1.04 | (0.41–2.60) | 1.61 | (0.62–4.23) | 0 | (-8–8) | 5 | (-5–16) |
| | 1991–94 | 0.66 | (0.29–1.52) | 1.16 | (0.45–2.97) | -3 | (-11–4) | 2 | (-9–12) |
| | 1996–99 | 1.74 | (0.39–7.67) | 1.54 | (0.31–7.71) | 3 | (-3–8) | 2 | (-5–8) |

**Table 82:** All-cause mortality rates per 100,000, by education

| | | No qualifications | | School qualifications | | Post–school qualifications | |
|---|---|---|---|---|---|---|---|
| All-cause: males | | | | | | | |
| 25–77 years | 1981–84 | 1156 | (1134–1179) | 991 | (936–1045) | 875 | (834–915) |
| | 1986–89 | 1106 | (1082–1130) | 957 | (919–994) | 850 | (824–876) |
| | 1991–94 | 1004 | (980–1029) | 848 | (819–877) | 769 | (747–791) |
| | 1996–99 | 881 | (860–902) | 735 | (709–760) | 662 | (643–681) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 25–44 years | 1981–84 | 215 | (197–232) | 160 | (134–185) | 125 | (107–143) |
| | 1986–89 | 217 | (198–236) | 181 | (158–203) | 134 | (121–147) |
| | 1991–94 | 222 | (201–242) | 162 | (143–181) | 143 | (130–155) |
| | 1996–99 | 228 | (207–250) | 146 | (130–162) | 125 | (112–137) |
| | P (trend) | < .01 | – | 0.31 | – | 0.94 | – |
| 45–59 years | 1981–84 | 895 | (859–931) | 727 | (645–810) | 653 | (593–712) |
| | 1986–89 | 834 | (795–873) | 680 | (615–745) | 623 | (585–661) |
| | 1991–94 | 717 | (682–753) | 554 | (502–607) | 528 | (497–558) |
| | 1996–99 | 631 | (599–662) | 475 | (438–512) | 414 | (389–438) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| 60–77 years | 1981–84 | 3940 | (3853–4027) | 3486 | (3251–3720) | 3107 | (2930–3284) |
| | 1986–89 | 3764 | (3668–3859) | 3327 | (3175–3479) | 3002 | (2891–3113) |
| | 1991–94 | 3404 | (3310–3499) | 3005 | (2891–3120) | 2704 | (2612–2797) |
| | 1996–99 | 2896 | (2821–2970) | 2595 | (2489–2702) | 2372 | (2292–2452) |
| | P (trend) | < .01 | – | < .01 | – | < .01 | – |
| All-cause: females | | | | | | | |
| 25–77 years | 1981–84 | 702 | (686–719) | 627 | (573–681) | 492 | (454–529) |
| | 1986–89 | 683 | (666–700) | 579 | (549–608) | 522 | (494–551) |
| | 1991–94 | 646 | (629–664) | 511 | (492–530) | 452 | (430–474) |
| | 1996–99 | 567 | (552–582) | 478 | (459–496) | 403 | (384–421) |
| | P (trend) | < .01 | – | < .01 | – | 0.05 | – |
| 25–44 years | 1981–84 | 122 | (111–134) | 87.4 | (70.3–105) | 97.1 | (78.1–116) |
| | 1986–89 | 113 | (101–125) | 77.7 | (65.5–89.8) | 80.6 | (68.2–93.0) |
| | 1991–94 | 122 | (110–135) | 68.8 | (59.1–78.4) | 70.4 | (61.5–79.3) |
| | 1996–99 | 112 | (99.5–125) | 80.0 | (71.1–88.9) | 62.9 | (54.7–71.1) |
| | P (trend) | 0.54 | – | 0.81 | – | < .01 | – |
| 45–59 years | 1981–84 | 528 | (501–554) | 476 | (410–542) | 349 | (304–395) |
| | 1986–89 | 498 | (472–525) | 423 | (377–469) | 361 | (325–398) |
| | 1991–94 | 465 | (440–491) | 401 | (363–438) | 327 | (299–354) |
| | 1996–99 | 428 | (404–451) | 332 | (304–359) | 303 | (279–327) |
| | P (trend) | < .01 | – | < .01 | – | 0.05 | – |
| 60–77 years | 1981–84 | 2258 | (2196–2319) | 2062 | (1836–2287) | 1576 | (1423–1728) |
| | 1986–89 | 2226 | (2162–2290) | 1928 | (1811–2045) | 1738 | (1620–1856) |
| | 1991–94 | 2077 | (2012–2143) | 1672 | (1601–1743) | 1488 | (1398–1578) |
| | 1996–99 | 1789 | (1737–1841) | 1574 | (1501–1648) | 1311 | (1236–1385) |
| | P (trend) | 0.05 | – | < .01 | – | 0.05 | – |

**Table 83:** All-cause mortality rate ratios and rate differences, by education

| | | Standardised rate ratios | | | | Standardised rate differences | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | No qualifications | | School qualifications | | No qualifications | | School qualifications | |
| All-cause: males | | | | | | | | | |
| 25–77 years | 1981–84 | 1.32 | (1.26–1.39) | 1.13 | (1.05–1.22) | 282 | (236–328) | 116 | (48–184) |
| | 1986–89 | 1.30 | (1.25–1.35) | 1.13 | (1.07–1.18) | 256 | (220–291) | 107 | (61–152) |
| | 1991–94 | 1.31 | (1.26–1.36) | 1.10 | (1.05–1.15) | 235 | (203–268) | 79 | (43–115) |
| | 1996–99 | 1.33 | (1.28–1.38) | 1.11 | (1.06–1.16) | 220 | (191–248) | 73 | (41–105) |
| 25–44 years | 1981–84 | 1.72 | (1.46–2.03) | 1.28 | (1.03–1.58) | 90 | (64–115) | 35 | (4–66) |
| | 1986–89 | 1.62 | (1.42–1.85) | 1.35 | (1.15–1.58) | 83 | (60–106) | 47 | (21–73) |
| | 1991–94 | 1.55 | (1.36–1.77) | 1.13 | (0.98–1.31) | 79 | (54–103) | 19 | (-4–42) |
| | 1996–99 | 1.83 | (1.60–2.10) | 1.17 | (1.01–1.36) | 104 | (79–129) | 21 | (1–41) |
| 45–59 years | 1981–84 | 1.37 | (1.24–1.51) | 1.11 | (0.96–1.29) | 242 | (173–311) | 75 | (-27–177) |
| | 1986–89 | 1.34 | (1.24–1.45) | 1.09 | (0.97–1.22) | 211 | (157–266) | 57 | (-18–132) |
| | 1991–94 | 1.36 | (1.26–1.47) | 1.05 | (0.94–1.17) | 190 | (143–237) | 27 | (-34–88) |
| | 1996–99 | 1.53 | (1.41–1.65) | 1.15 | (1.04–1.27) | 217 | (177–257) | 61 | (17–106) |
| 60–77 years | 1981–84 | 1.27 | (1.19–1.35) | 1.12 | (1.03–1.23) | 833 | (636–1031) | 379 | (85–673) |
| | 1986–89 | 1.25 | (1.20–1.31) | 1.11 | (1.05–1.18) | 762 | (615–909) | 326 | (137–514) |
| | 1991–94 | 1.26 | (1.20–1.32) | 1.11 | (1.06–1.17) | 700 | (568–832) | 301 | (154–448) |
| | 1996–99 | 1.22 | (1.17–1.27) | 1.09 | (1.04–1.15) | 524 | (414–633) | 223 | (90–357) |
| All-cause: females | | | | | | | | | |
| 25–77 years | 1981–84 | 1.43 | (1.32–1.55) | 1.28 | (1.14–1.43) | 211 | (170–252) | 135 | (70–201) |
| | 1986–89 | 1.31 | (1.23–1.39) | 1.11 | (1.03–1.19) | 161 | (127–194) | 56 | (15–97) |
| | 1991–94 | 1.43 | (1.35–1.51) | 1.13 | (1.06–1.20) | 194 | (166–222) | 59 | (30–88) |
| | 1996–99 | 1.41 | (1.34–1.48) | 1.19 | (1.12–1.26) | 164 | (141–188) | 75 | (49–101) |
| 25–44 years | 1981–84 | 1.26 | (1.01–1.57) | 0.90 | (0.68–1.19) | 25 | (3–48) | -10 | (-35–16) |
| | 1986–89 | 1.40 | (1.16–1.69) | 0.96 | (0.77–1.20) | 32 | (15–50) | -3 | (-20–14) |
| | 1991–94 | 1.74 | (1.48–2.05) | 0.98 | (0.81–1.18) | 52 | (36–68) | -2 | (-15–12) |
| | 1996–99 | 1.79 | (1.50–2.13) | 1.27 | (1.07–1.51) | 50 | (34–65) | 17 | (5–29) |
| 45–59 years | 1981–84 | 1.51 | (1.31–1.74) | 1.36 | (1.13–1.65) | 179 | (126–231) | 127 | (47–207) |
| | 1986–89 | 1.38 | (1.23–1.55) | 1.17 | (1.01–1.36) | 137 | (92–182) | 62 | (3–120) |
| | 1991–94 | 1.42 | (1.29–1.58) | 1.23 | (1.08–1.39) | 139 | (101–176) | 74 | (28–121) |
| | 1996–99 | 1.41 | (1.28–1.55) | 1.09 | (0.98–1.22) | 124 | (91–158) | 28 | (-8–64) |
| 60–77 years | 1981–84 | 1.43 | (1.30–1.58) | 1.31 | (1.13–1.51) | 682 | (518–847) | 486 | (214–758) |
| | 1986–89 | 1.28 | (1.19–1.38) | 1.11 | (1.01–1.22) | 488 | (354–622) | 190 | (24–356) |
| | 1991–94 | 1.40 | (1.30–1.49) | 1.12 | (1.04–1.21) | 589 | (478–700) | 184 | (69–298) |
| | 1996–99 | 1.36 | (1.28–1.46) | 1.20 | (1.12–1.29) | 478 | (387–569) | 264 | (159–369) |

**Table 84:** All-cause mortality rates per 100,000 by ethnicity and income, 25–77-year-olds only

| Ethnicity | Sex | Cohort | Low income | | Medium and high income | |
|---|---|---|---|---|---|---|
| Māori | Males | 1981–84 | 1851 | (1671–2032) | 1574 | (1358–1789) |
| | | 1986–89 | 1734 | (1577–1891) | 1366 | (1192–1540) |
| | | 1991–94 | 1856 | (1720–1992) | 1449 | (1225–1673) |
| | | 1996–99 | 1830 | (1709–1951) | 1149 | (1029–1269) |
| | Females | 1981–84 | 1390 | (1234–1545) | 999 | (825–1173) |
| | | 1986–89 | 1286 | (1160–1412) | 997 | (800–1193) |
| | | 1991–94 | 1236 | (1132–1340) | 1065 | (872–1258) |
| | | 1996–99 | 1257 | (1159–1356) | 929 | (774–1085) |
| Non-Māori non-Pacific | Males | 1981–84 | 1198 | (1164–1232) | 899 | (875–924) |
| | | 1986–89 | 1094 | (1064–1123) | 814 | (793–834) |
| | | 1991–94 | 970 | (945–996) | 676 | (658–695) |
| | | 1996–99 | 838 | (814–862) | 574 | (557–591) |
| | Females | 1981–84 | 657 | (636–679) | 541 | (520–561) |
| | | 1986–89 | 630 | (611–650) | 503 | (485–521) |
| | | 1991–94 | 558 | (541–574) | 432 | (416–447) |
| | | 1996–99 | 496 | (480–511) | 369 | (354–383) |

**Table 85:** All-cause mortality rates per 100,000, by ethnicity and education, 25–77-year-olds only

| Ethnicity | Sex | Cohort | Low income | | Medium and high income | |
|---|---|---|---|---|---|---|
| Māori | Males | 1981–84 | 1838 | (1703–1973) | 1161 | (875–1447) |
| | | 1986–89 | 1683 | (1557–1809) | 1214 | (1047–1380) |
| | | 1991–94 | 1814 | (1693–1936) | 1527 | (1347–1706) |
| | | 1996–99 | 1770 | (1667–1873) | 1375 | (1261–1489) |
| | Females | 1981–84 | 1359 | (1230–1487) | 1272 | (671–1872) |
| | | 1986–89 | 1321 | (1209–1433) | 962 | (753–1172) |
| | | 1991–94 | 1328 | (1227–1428) | 866 | (733–999) |
| | | 1996–99 | 1304 | (1214–1395) | 978 | (867–1090) |
| Non-Māori non-Pacific | Males | 1981–84 | 1110 | (1087–1133) | 904 | (872–935) |
| | | 1986–89 | 1058 | (1033–1083) | 870 | (849–892) |
| | | 1991–94 | 951 | (926–976) | 761 | (744–778) |
| | | 1996–99 | 813 | (791–835) | 649 | (634–665) |
| | Females | 1981–84 | 662 | (645–678) | 524 | (496–552) |
| | | 1986–89 | 641 | (624–658) | 520 | (501–539) |
| | | 1991–94 | 603 | (585–621) | 452 | (439–466) |
| | | 1996–99 | 522 | (507–537) | 400 | (388–413) |

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