87 to 169. The test for trend was significant in both instances- p-values of 0.01 and 0.02 respectively. Furthermore, whereas in the earlier cohorts the RII is higher at younger ages by 1996-99 the RII for the older age group is higher – 1.79 (95% CI: 1.30-2.46) compared to 1.59 (95% CI: 1.09-2.31).

Males: For 25-44 year old males, there is some evidence of a decline in mortality for classes three, four and five but the mortality rate of the highest class remains fairly constant across the four cohorts (Figure 7-4). The SRD between classes five and six widens substantially over the cohorts from 20 to 55 per 100,000 person-years. The rate of mortality for farmers also shows no decline in this age group. The net effect is that no particular trend of either increasing or decreasing relative or absolute inequality is evident from the class specific SRR and SRD or the RII and SII. The RII for mortality by occupation is however substantial in all cohorts in for young men – 2.95, 3.29, 2.03 and 3.77 for the consecutive cohorts. The SII remains constant, except for a possible dip in 1991-94, when the RII was also lowest.

In comparison all classes, including farmers, show substantial declines in mortality for the 45-59 year old age group. There is a clear association of higher mortality with lower occupational class but class six does not show the substantial disadvantage over class five that is evident among 25-45 year old cohortees. Instead the mortality rate of class six is lower than that of class five in all four cohorts for this age group. Mortality rates declined by 392, 393, 390, 374, 392 and 441 per 100,000 person-years for classes one through six. This represented proportionate declines of 51%, 48%, 44%, 41%, 38%, and 44% for the six classes respectively. Thus similar levels of absolute decline translate into greater proportional declines in mortality for the higher classes.

The overall impact of these differential declines in mortality for males aged 45-59 is an increase in RII from 1.52 to 2.23 across the four cohorts (p-value for test of trend = 0.08). The SII however remains relatively constant.

Table 7-6 All Cause Mortality by Occupational Class – RII and SII by Cohort Period, Sex and Age

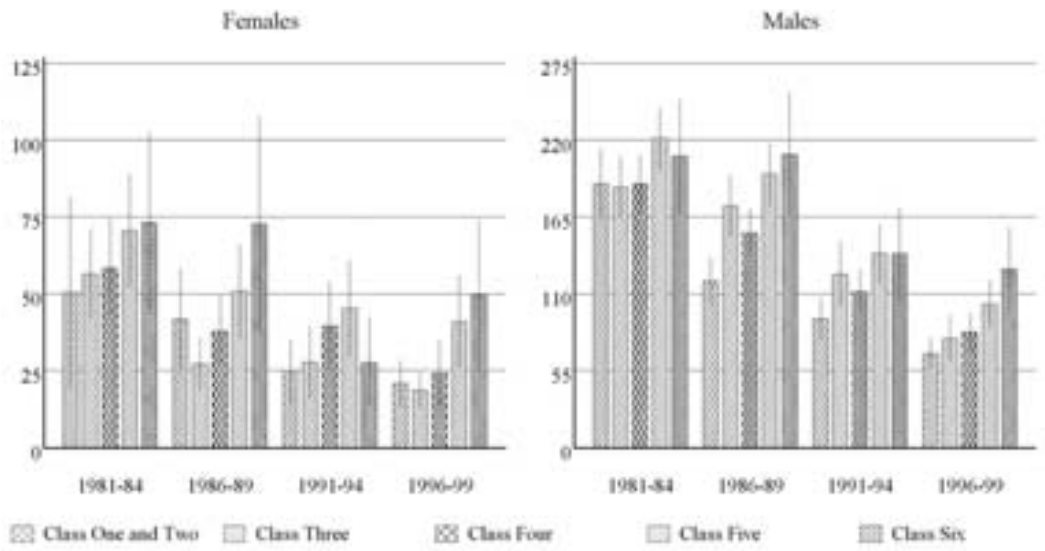
Sex	Age	Period	RII* (95% CI)	P (Trend)	SII* (95% CI)	P (Trend)
Females	25-44 yrs	1981-84	1.70 (1.09- 2.66)	.	42 (-4- 87)	.
		1986-89	1.60 (1.09- 2.34)	.	34 (7- 62)	.
		1991-94	1.92 (1.23- 3.02)	.	39 (8- 70)	.
		1996-99	1.59 (1.09- 2.31)	0.904	26 (4- 48)	0.200
	45-59 yrs	1981-84	1.23 (0.93- 1.63)	.	87 (-30- 203)	.
		1986-89	1.39 (1.01- 1.90)	.	120 (-43- 283)	.
		1991-94	1.50 (1.07- 2.09)	.	131 (71- 192)	.
		1996-99	1.79 (1.30- 2.46)	0.011	169 (107- 231)	0.023
Males	25-44 yrs	1981-84	2.95 (2.13- 4.10)	.	150 (122- 178)	.
		1986-89	3.29 (2.34- 4.61)	.	156 (110- 202)	.
		1991-94	2.03 (1.51- 2.74)	.	90 (42- 139)	.
		1996-99	3.77 (2.46- 5.78)	0.907	145 (80- 210)	0.459
	45-59 yrs	1981-84	1.52 (1.31- 1.77)	.	373 (264- 481)	.
		1986-89	1.89 (1.60- 2.23)	.	488 (261- 716)	.
		1991-94	1.84 (1.49- 2.28)	.	339 (269- 409)	.
		1996-99	2.23 (1.76- 2.81)	0.078	390 (311- 469)	0.977

*age and ethnicity standardised

7.2.2 Cardiovascular Disease

Figure 7-5 shows CVD mortality by occupational class by sex and cohort. Mortality rates, SRD and SRR are given in Table 7-8 and Table 7-9. RII and SII are given in Figure 7-6 and Table 7-7. For these analyses classes one and two are combined.

Figure 7-5 CVD Mortality Rates* by Occupational Class, Sex and Cohort - ages 25-59 years



*age and ethnicity standardised per 100,000 person-years

Figure 7-5 shows an association between CVD mortality and occupational class, although the association is not monotonic for all four cohorts for either males or females. CVD mortality rates declined in all occupational classes for both male and females.

Trends in relative inequality: For females, the SRR for the lower classes relative to classes one and two increase across the four cohorts from 1.40 and 1.45 for classes five and six in 1981-84 to 1.96 and 2.37 in 1996-99. The RII for each consecutive cohort were 1.52, 2.00, 2.05, and 3.27; thus showing a consistent and substantial increase over the four cohorts (p-value for test of trend = 0.06).

This pattern of increasing relative inequality is also seen for males although the increases have not been consistent across all time periods. The SRR for the lower classes relative to classes one and two increase across the four cohorts from 1.17 and 1.10 for classes five and six in 1981-84 to 1.52 and 1.89 in 1996-99. The RII for the four consecutive cohorts were 1.22, 1.78, 1.63 and 2.00.

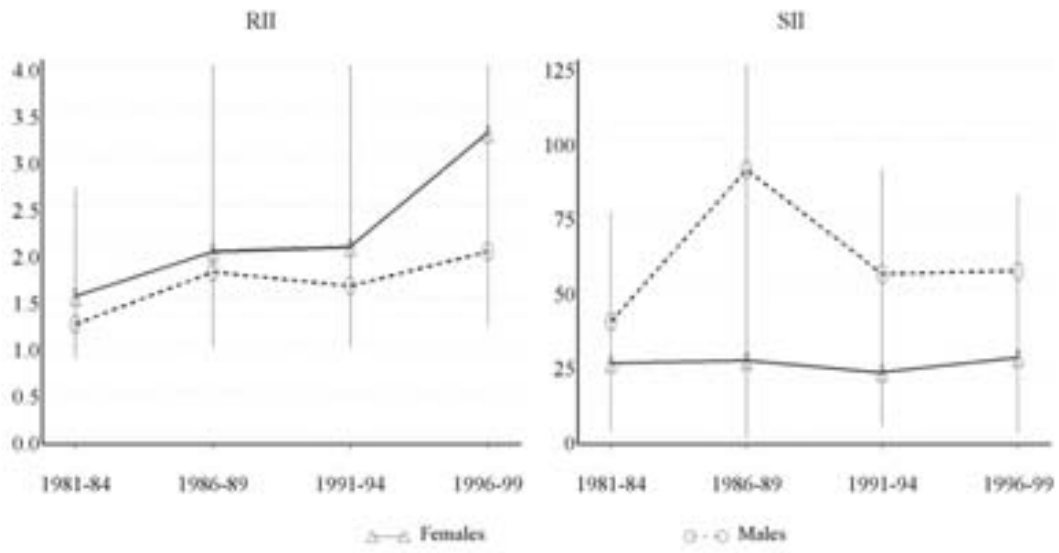
Trends in absolute inequality: For females The SRD are quite unstable but the SII remains relatively constant suggesting no change in absolute inequality over the four cohorts. For males, the SII measure was highest in 1986-89 but subsequent declines in mortality in all classes meant this declines substantially in the 1990s.

Table 7-7 CVD Mortality by Occupational Class* - RII and SII, Sex, and Cohort

Sex	Cohort	RII (95% CI) †	P (Trend)	SII (95% CI) †	P (Trend)
Females	1981-84	1.52 (0.86- 2.68)	.	25 (15- 35)	.
	1986-89	2.00 (0.99- 4.04)	.	26 (-13- 65)	.
	1991-94	2.05 (0.98- 4.28)	.	22 (4- 40)	.
	1996-99	3.27 (1.21- 8.80)	0.06	27 (2- 52)	0.84
Males	1981-84	1.22 (1.00- 1.49)	.	39 (2- 76)	.
	1986-89	1.78 (1.41- 2.25)	.	90 (30- 150)	.
	1991-94	1.63 (1.22- 2.17)	.	55 (20- 90)	.
	1996-99	2.00 (1.41- 2.83)	0.15	56 (30- 81)	0.69

* Occupational Classes one and two combined
† age and ethnicity standardised

Figure 7-6 CVD Mortality by Occupational Class -RII and SII, Sex, and Cohort*†



* Occupational Classes one and two combined
† age and ethnicity standardised

Table 7-8 CVD Mortality Rates (per 100,000 person-years), SRR and SRD by Occupational Class and Cohort –Females ages 25-59 years

Cohort	Occupational Class	Deaths (n)	Crude Rate	Std Rate*	Ethnicity Std Rate†	SRR (95% CI)†	SRD (95% CI)†
1981-84	Class One and Two	48	34.2	39.3	50.5	0.87 (0.44- 1.71)	-7.8 (-43.0- 27.4)
	Class Three	144	42.9	51.0	56.5	0.97 (0.66- 1.42)	-1.8 (-23.7- 20.1)
	Class Four	114	53.4	54.9	58.3	1.00 -	0.0 -
	Class Five	129	66.7	73.6	70.7	1.21 (0.83- 1.77)	12.4 (-12.1- 36.9)
	Class Six	54	79.4	81.3	73.2	1.26 (0.77- 2.05)	14.9 (-18.7- 48.5)
	Farmers	36	44.0	54.9	54.6	0.94 (0.53- 1.67)	-3.7 (-35.7- 28.3)
1986-89	Class One and Two	60	27.8	39.4	41.7	1.10 (0.66- 1.84)	3.9 (-16.6- 24.4)
	Class Three	90	21.2	25.1	27.2	0.72 (0.46- 1.12)	-10.6 (-25.3- 4.1)
	Class Four	84	34.0	36.0	37.8	1.00 -	0.0 -
	Class Five	99	46.0	54.4	50.8	1.34 (0.87- 2.08)	13.0 (-6.6- 32.6)
	Class Six	48	71.9	85.0	72.8	1.93 (1.08- 3.42)	35.0 (-2.0- 72.0)
	Farmers	27	24.8	37.9	37.7	1.00 (0.50- 1.98)	-0.1 (-25.9- 25.7)
1991-94	Class One and Two	57	17.9	27.6	25.0	0.63 (0.37- 1.08)	-14.6 (-32.1- 2.9)
	Class Three	93	20.3	23.8	27.8	0.70 (0.40- 1.22)	-11.8 (-30.3- 6.7)
	Class Four	72	29.3	34.3	39.6	1.00 -	0.0 -
	Class Five	81	42.0	49.2	45.3	1.14 (0.69- 1.89)	5.7 (-15.5- 26.9)
	Class Six	27	38.7	33.1	27.7	0.70 (0.37- 1.33)	-11.9 (-32.5- 8.7)
	Farmers	24	26.0	26.9	36.3	0.92 (0.43- 1.94)	-3.3 (-31.1- 24.5)
1996-99	Class One and Two	69	16.2	20.6	20.9	0.86 (0.49- 1.52)	-3.3 (-16.3- 9.7)
	Class Three	87	16.4	18.1	18.6	0.77 (0.45- 1.32)	-5.6 (-17.7- 6.5)
	Class Four	45	18.0	23.8	24.2	1.00 -	0.0 -
	Class Five	84	36.3	43.6	41.0	1.69 (0.96- 3.00)	16.8 (-1.5- 35.1)
	Class Six	39	42.2	52.0	49.5	2.05 (1.06- 3.96)	25.3 (-1.3- 51.9)
	Farmers	18	17.1	15.6	16.0	0.66 (0.31- 1.40)	-8.2 (-22.6- 6.2)

*age standardised per 100,000 person-years
†age and ethnicity standardised per 100,000 person-years

Table 7-9 CVD Mortality Rates (per 100,000 person-years), SRR and SRD by Occupational Class and Cohort –Males ages 25-59 years

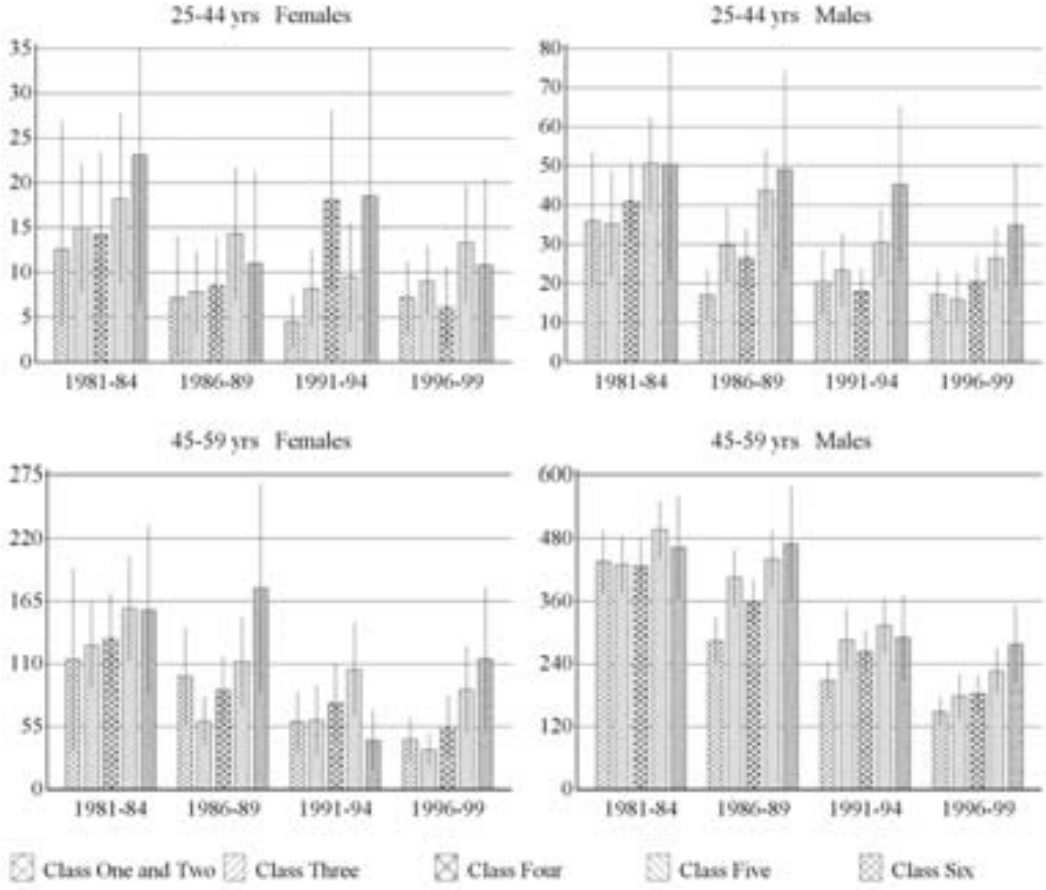
Cohort	Occupational Class	Deaths (n)	Crude Rate	Std Rate*	Ethnicity Std Rate†	SRR (95% CI)†	SRD (95% CI)†
1981-84	Class One and Two	543	156.6	177.0	188.9	1.00 (0.84- 1.19)	0.3 (-32.6- 33.2)
	Class Three	546	171.5	183.0	186.2	0.99 (0.84- 1.16)	-2.4 (-32.9- 28.1)
	Class Four	681	156.7	183.4	188.6	1.00 -	0.0 -
	Class Five	789	217.8	232.3	221.2	1.17 (1.01- 1.36)	32.6 (2.3- 62.9)
	Class Six	180	219.8	210.5	208.3	1.10 (0.88- 1.39)	19.7 (-26.8- 66.2)
	Farmers	273	139.7	154.2	154.5	0.82 (0.67- 1.00)	-34.1 (-67.8- -0.4)
1986-89	Class One and Two	438	101.7	113.8	119.1	0.77 (0.64- 0.93)	-34.8 (-59.1- -10.5)
	Class Three	477	139.6	166.4	173.2	1.13 (0.95- 1.33)	19.3 (-8.6- 47.2)
	Class Four	597	123.5	150.7	153.9	1.00 -	0.0 -
	Class Five	642	173.8	207.0	195.5	1.27 (1.08- 1.49)	41.6 (13.8- 69.4)
	Class Six	174	216.0	228.9	209.8	1.36 (1.07- 1.73)	55.9 (8.4- 103.4)
	Farmers	237	114.5	131.6	138.7	0.90 (0.71- 1.14)	-15.2 (-49.0- 18.6)
1991-94	Class One and Two	354	74.2	82.2	92.3	0.83 (0.67- 1.03)	-19.4 (-41.3- 2.5)
	Class Three	255	86.0	112.7	123.9	1.11 (0.88- 1.41)	12.2 (-16.1- 40.5)
	Class Four	369	83.1	107.6	111.7	1.00 -	0.0 -
	Class Five	372	118.7	148.2	138.9	1.24 (1.01- 1.53)	27.2 (0.9- 53.5)
	Class Six	129	143.8	167.7	138.8	1.24 (0.94- 1.65)	27.1 (-10.0- 64.2)
	Farmers	141	77.5	85.8	92.0	0.82 (0.63- 1.08)	-19.7 (-46.6- 7.2)
1996-99	Class One and Two	318	58.1	62.3	67.4	0.82 (0.65- 1.03)	-15.1 (-32.7- 2.5)
	Class Three	183	60.3	73.3	78.3	0.95 (0.72- 1.25)	-4.2 (-26.0- 17.6)
	Class Four	297	64.9	80.8	82.5	1.00 -	0.0 -
	Class Five	315	96.6	116.4	102.6	1.24 (0.98- 1.57)	20.1 (-1.9- 42.1)
	Class Six	162	135.5	152.7	127.7	1.55 (1.16- 2.07)	45.2 (12.0- 78.4)
	Farmers	132	72.6	71.7	72.6	0.88 (0.66- 1.17)	-9.9 (-31.7- 11.9)

*age standardised per 100,000 person-years
†age and ethnicity standardised per 100,000 person-years

7.2.2.1 Variations by age in CVD mortality by Occupational Class

Figure 7-6 shows CVD mortality rates for two age groups separately – ages 25-44 years and 45-59 years. These results show that CVD mortality was associated with occupational class in both age groups, for both sexes in all cohorts, except for 45-59 year old males in 1981-84. Mortality rates fell for all classes, for both male and females over the period of the four cohorts.

Figure 7-7 CVD Mortality Rates* by Occupational Class, Sex, Age and Cohort



*age and ethnicity standardised per 100,000 person-years

The confidence intervals around the mortality rates and inequality measures are very unstable for younger females. This instability makes interpretation of trends in the RII and SII unclear, for all age and sex groups except 45-59 year old males for whom the RII increases substantially from 1.17 in 1981-84 to 1.99 in 1996-99 (Table 7-10). The SII for

45-59 year old s was greatest in 1986-89 but fell with the declining CVD mortality in all classes in the 1990s.

Table 7-10 CVD Mortality by Occupational Class -RII and SII, Sex, and Cohort*

Sex	Age	Cohort	RII† (95% CI)	P (Trend)	SII† (95% CI)	P (Trend)
Females	25-44 yrs	1981-84	1.69 (0.54- 5.30)	.	8 (2- 14)	.
		1986-89	2.34 (0.62- 8.80)	.	7 (1- 14)	.
		1991-94	5.54 (0.52- 59.50)	.	14 (1- 27)	.
		1996-99	1.75 (0.64- 4.77)	0.96	5 (-3- 12)	0.68
	45-59 yrs	1981-84	1.49 (0.79- 2.78)	.	53 (32- 73)	.
		1986-89	2.07 (0.92- 4.62)	.	62 (-35- 160)	.
		1991-94	1.70 (0.76- 3.78)	.	36 (-21- 93)	.
		1996-99	4.11 (1.02- 16.55)	0.27	66 (5- 127)	0.93
Males	25-44 yrs	1981-84	1.66 (0.92- 3.00)	.	21 (11- 30)	.
		1986-89	3.44 (1.56- 7.59)	.	33 (15- 50)	.
		1991-94	1.95 (0.98- 3.87)	.	15 (-7- 37)	.
		1996-99	2.29 (1.13- 4.62)	0.69	16 (6- 27)	0.48
	45-59 yrs	1981-84	1.17 (0.94- 1.44)	.	68 (-14- 151)	.
		1986-89	1.68 (1.31- 2.16)	.	189 (60- 318)	.
		1991-94	1.63 (1.18- 2.25)	.	125 (47- 203)	.
		1996-99	1.99 (1.35- 2.95)	0.10	122 (68- 176)	0.55

* Occupational Classes one and two combined
† age and ethnicity standardised

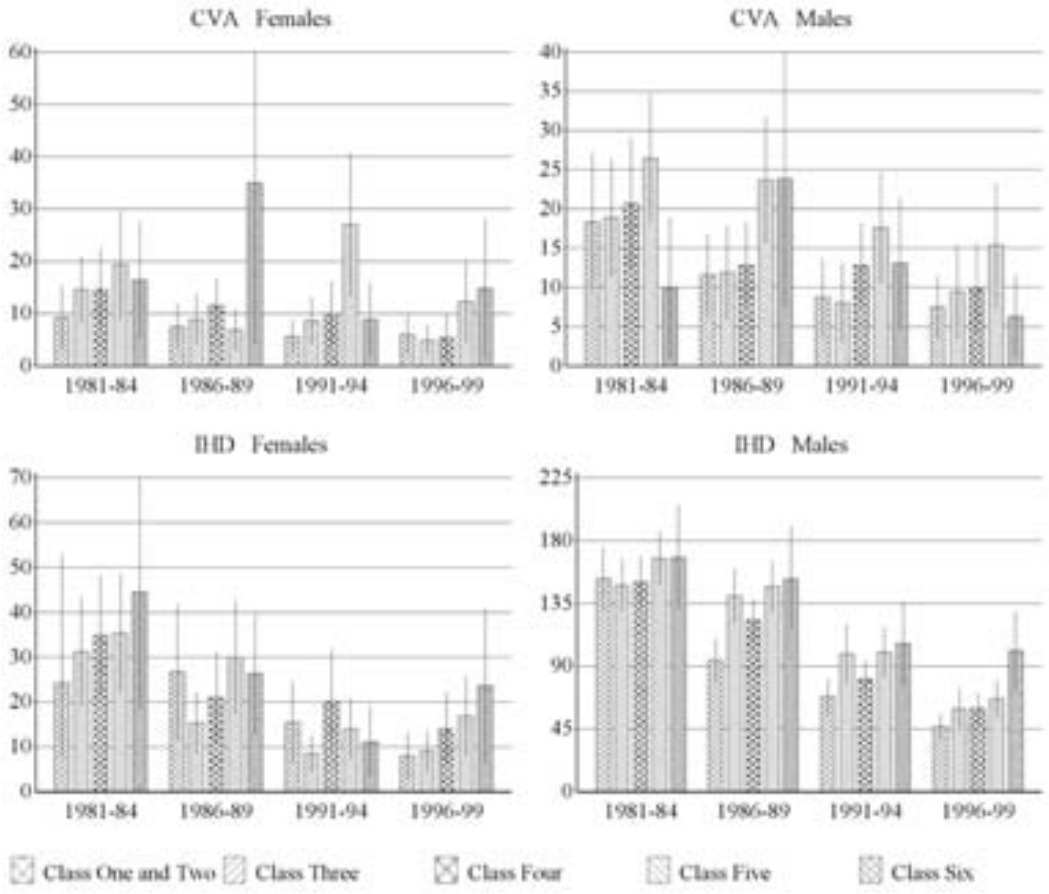
7.2.2.2 Trends in IHD and Stroke mortality by occupational class

Mortality rates for Stroke and IHD are shown in Figure 7-8, below.

IHD Mortality: For females, the confidence intervals around the IHD mortality rates are wide and the association between IHD and occupational class is less consistent than the association with overall CVD. Mortality rates increase with decreasing social class in the first and last cohort but there is no clear pattern in the middle two cohorts. Summary measures of inequality were too imprecise for inclusion.

For males, the association between IHD mortality and occupational class strengthens over time mirrors those for CVD – that is increasing relative inequality and stable absolute inequality. The RII for IHD increased from 1.14 to 2.02 (p-value for test of trend = 0.09).

Figure 7-8 Stroke and IHD Mortality Rates* by Occupational Class, Cohort Period and Sex



*age and ethnicity standardised per 100,000 person-years
Mortality rates and 95%CIs are given in the appendices, Table 12-42 to Table 12-45 pages 437-440).

Stroke Mortality: The Stroke mortality rates were very imprecise for females, however rates were generally higher in the lower classes (five and six) than the higher classes (one and two). For males Stroke mortality is associated with occupational class for classes one to five but classes six rates are substantially lower than all other classes in the first and last cohort. Both relative and absolute inequality measures peaked in 1986-89 and decreased thereafter.

Table 7-11 Stroke and IHD Mortality by Occupational Class – RII and SII by Cohort and Cause of Death – males aged 25-59 years.

Cause	Period	RII (95% CI)†	P (Trend)	SII (95% CI) †	P (Trend)
Stroke	1981-84	1.32 (0.68- 2.55)	.	6 (-9- 21)	.
	1986-89	3.02 (1.09- 8.42)	.	15 (4- 27)	.
	1991-94	2.76 (0.97- 7.88)	.	11 (4- 18)	.
	1996-99	1.96 (0.67- 5.72)	0.40	6 (-3- 16)	0.62
IHD	1981-84	1.14 (0.92- 1.42)	.	21 (-1- 43)	.
	1986-89	1.62 (1.26- 2.08)	.	59 (10- 109)	.
	1991-94	1.56 (1.11- 2.18)	.	37 (-0- 74)	.
	1996-99	2.02 (1.33- 3.07)	0.09	40 (11- 69)	0.34

* Occupational Classes one and two combined
† age and ethnicity standardised per 100,000 person-years

7.2.3 Mortality by manual and non-Manual class and Cause of Death

The small number of deaths due to cancer and injury for cohortees in the occupational class-restricted cohorts, made consideration of the class-specific mortality rates inaccurate. Instead the contribution of different causes to the overall mortality for manual and non-manual classes, classified according to the EGP classification, is considered (section 3.3.3.2, page 104). Figure 7-9 shows mortality rates for manual and non-manual classes by sex and age group Table 7-12 and Table 7-13 give the SRR and SRD for manual versus non-manual classes.

For all cause mortality nonon-manual mortality rates are always less for the manual class but the relative inequality is greater for men than for women. Furthermore CVD fall for both manual and non-manual classes in each age group and as a consequence CVD contributes a declining proportion of all cause mortality rates for both manual and non-manual classes (Figure 7-10).

7.2.3.1 CVD

For females the manual:non-Manual SRR is highest in the second and fourth cohorts and lowest in the third cohort. The SRR is always higher for 45-59 year olds than for 25-44 year olds. The SRD is lower in the 1990s than the 1980s, reflecting the substantial decline in CVD mortality rates. For females CVD accounts for almost all the differential in mortality between manual and non-manual classes.

For males, the CVD manual:non-Manual SRR shows a consistent increase between 1981-84 and 1996-99, in the 45-59 age group only. Unlike females, the SRR is highest in the youngest age group for males. Trends in absolute inequality vary by age; the SRD for 25-59 year old males declines over the time period but for older males increases substantially in the first inter-cohort period and remains stable thereafter. For all ages combined there is no change in the SRD over time.

7.2.3.2 Lung Cancer

Lung cancer mortality is a relatively uncommon cause of death for females aged 25-59 years, nevertheless there is a trend for increasing disparities between manual and non-manual classes, which is most apparent in the 45-59 year old age group. SRR increased between 1981-84 and 1996-99 from 1.37 to 1.83. The SRD increases over the first two inter-cohort periods but then remains constant.

For males, relative inequalities in lung cancer mortality are substantial in all four cohorts but are greatest for the second cohort and decline thereafter to remain stable from 1991-94 to 1996-99. A similar trend is seen for absolute inequalities. The SRD are greatest in 1986-89 but decline and remain stable in the 1990s.

7.2.3.3 Non-Lung Cancers

For females, non-lung cancers contribute substantially to overall mortality rates in all four cohorts, for both manual and non-manual classes. Mortality from non-lung cancers remained stable across the cohorts and are not consistently associated with manual :non-Manual class status in any of the four cohorts for both males and females.

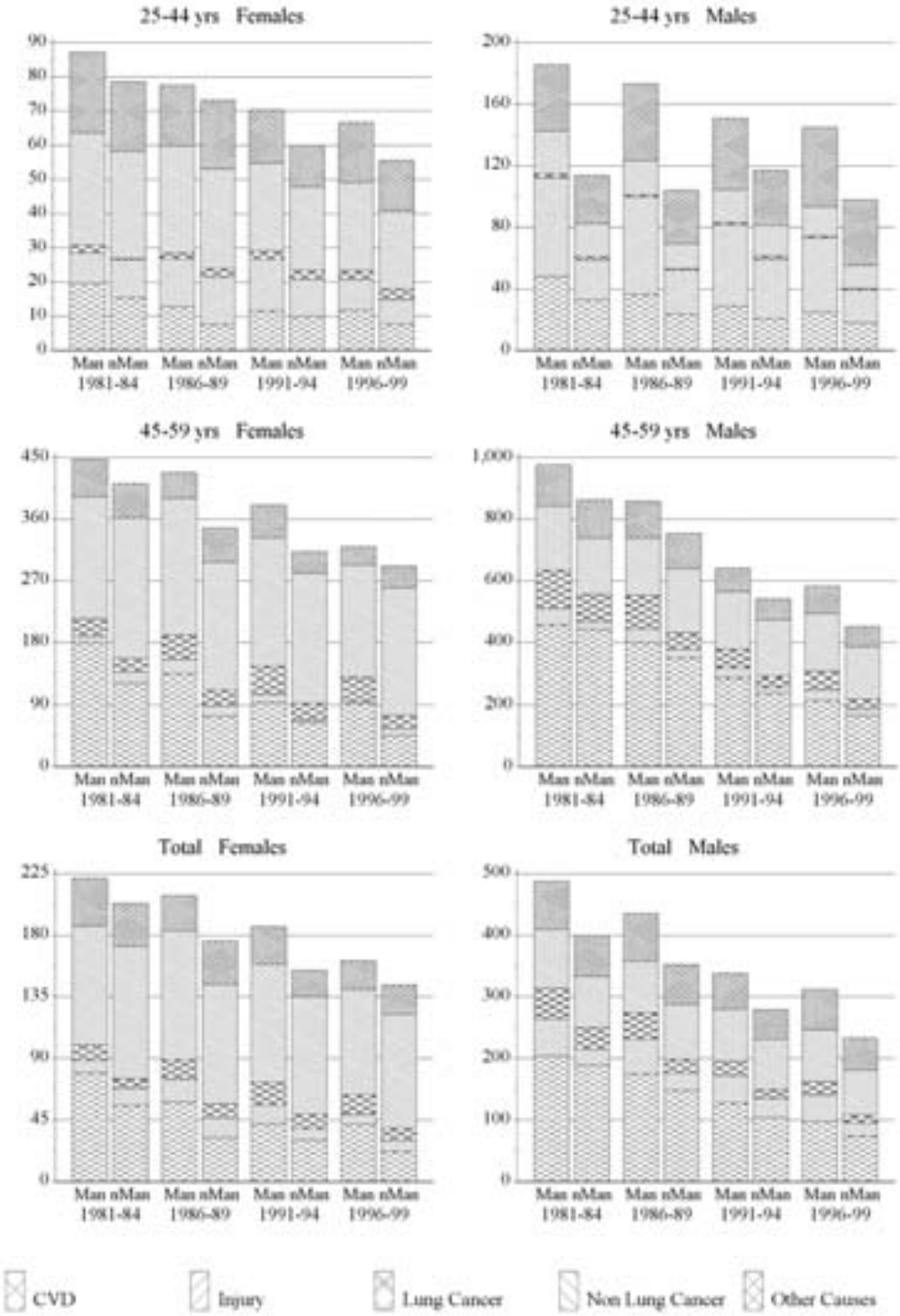
7.2.3.4 Injury

Trends in mortality rates by injury varied by age, sex and manual/non-Manual class. Mortality rates for females were generally about half those for males, in each age and class strata.

Among males, manual classes experienced a consistent decline in mortality between 1981-84 and 1996-99 but the non-Manual class showed a small increase in mortality up until 1991-94 after with a substantial decline in the last inter-cohort period.

In general there was little difference between the mortality rates of manual and non-Manual female cohortees.

Figure 7-9 Mortality rates* by Manual-non-Manual status of Occupation, by Sex, Age and Cohort



*age and ethnicity standardised
Mortality rates and 95%CIs are given in the appendices, Table 12-46,page 441.

Table 7-12 Manual / non-Manual SRR and SRD by Sex, Age, Cohort and Cause of Death - Females

Cause	Cohort	SRR (95%CI)*			SRD (95%CI)*†		
		Age			Age		
		25-44 yrs	45-59 yrs	Total	25-44 yrs	45-59 yrs	Total
All Causes	1981-84	1.11 (0.86- 1.43)	1.09 (0.91- 1.30)	1.09 (0.94- 1.27)	8.7 (-12.4- 29.8)	35.2 (-41.9- 112.2)	18.6 (-13.1- 50.3)
	1986-89	1.06 (0.83- 1.35)	1.23 (1.02- 1.49)	1.19 (1.02- 1.39)	4.4 (-13.9- 22.7)	81.2 (5.0- 157.4)	33.2 (2.4- 63.9)
	1991-94	1.17 (0.91- 1.51)	1.22 (1.00- 1.49)	1.21 (1.02- 1.42)	10.3 (-6.6- 27.3)	67.9 (-4.5- 140.3)	31.9 (2.8- 61.0)
	1996-99	1.20 (0.96- 1.51)	1.10 (0.91- 1.32)	1.12 (0.97- 1.30)	11.1 (-3.3- 25.6)	28.4 (-28.7- 85.5)	17.6 (-5.6- 40.8)
CVD	1981-84	1.27 (0.72- 2.23)	1.47 (1.05- 2.06)	1.43 (1.06- 1.93)	4.2 (-5.8- 14.2)	57.1 (5.7- 108.5)	24.0 (3.8- 44.2)
	1986-89	1.69 (0.92- 3.11)	1.82 (1.24- 2.67)	1.80 (1.28- 2.53)	5.2 (-1.4- 11.8)	60.5 (17.0- 104.0)	25.9 (9.1- 42.7)
	1991-94	1.15 (0.62- 2.13)	1.45 (0.94- 2.25)	1.39 (0.96- 2.02)	1.5 (-5.3- 8.3)	29.2 (-7.5- 65.8)	11.9 (-2.5- 26.2)
	1996-99	1.54 (0.90- 2.64)	2.00 (1.30- 3.09)	1.90 (1.32- 2.74)	4.2 (-1.6- 9.9)	45.8 (11.8- 79.8)	19.8 (6.5- 33.0)
Lung Cancer	1981-84	7.05 (0.72- 69.42)	1.37 (0.66- 2.86)	1.52 (0.76- 3.04)	1.8 (-0.7- 4.3)	7.1 (-9.6- 23.8)	3.8 (-2.7- 10.2)
	1986-89	0.65 (0.15- 2.78)	1.58 (0.81- 3.07)	1.44 (0.78- 2.66)	-0.8 (-3.4- 1.8)	13.1 (-7.7- 33.9)	4.4 (-3.6- 12.3)
	1991-94	0.93 (0.32- 2.72)	1.71 (0.79- 3.67)	1.59 (0.79- 3.20)	-0.2 (-2.7- 2.3)	16.7 (-11.9- 45.3)	6.1 (-4.7- 16.9)
	1996-99	0.82 (0.30- 2.25)	1.83 (1.08- 3.08)	1.60 (1.01- 2.55)	-0.6 (-3.4- 2.2)	15.4 (0.9- 30.0)	5.4 (-0.3- 11.1)
Non Lung Cancer	1981-84	1.05 (0.71- 1.54)	0.87 (0.67- 1.13)	0.91 (0.73- 1.13)	1.5 (-11.0- 14.0)	-27.0 (-76.2- 22.2)	-9.2 (-29.2- 10.8)
	1986-89	1.07 (0.76- 1.51)	1.08 (0.83- 1.41)	1.08 (0.86- 1.35)	2.1 (-8.5- 12.6)	14.8 (-36.9- 66.5)	6.8 (-13.6- 27.3)
	1991-94	1.05 (0.73- 1.51)	1.00 (0.76- 1.31)	1.01 (0.80- 1.27)	1.2 (-8.0- 10.4)	-0.8 (-51.7- 50.1)	0.4 (-19.5- 20.4)
	1996-99	1.14 (0.80- 1.62)	0.88 (0.70- 1.12)	0.93 (0.76- 1.14)	3.2 (-5.6- 12.0)	-21.7 (-61.9- 18.5)	-6.1 (-22.1- 9.9)
Injury	1981-84	0.80 (0.37- 1.72)	0.62 (0.27- 1.41)	0.72 (0.41- 1.27)	-2.2 (-9.6- 5.1)	-5.6 (-14.5- 3.4)	-3.5 (-9.2- 2.2)
	1986-89	1.02 (0.56- 1.84)	1.37 (0.55- 3.43)	1.15 (0.68- 1.95)	0.2 (-8.1- 8.5)	5.5 (-11.8- 22.7)	2.2 (-6.1- 10.5)
	1991-94	1.40 (0.75- 2.63)	2.81 (1.20- 6.59)	1.65 (0.99- 2.76)	4.3 (-4.4- 13.1)	7.1 (-0.3- 14.5)	5.4 (-0.7- 11.5)
	1996-99	1.27 (0.64- 2.54)	0.40 (0.15- 1.10)	0.87 (0.49- 1.54)	1.9 (-3.8- 7.6)	-6.0 (-11.9- -0.1)	-1.1 (-5.3- 3.2)

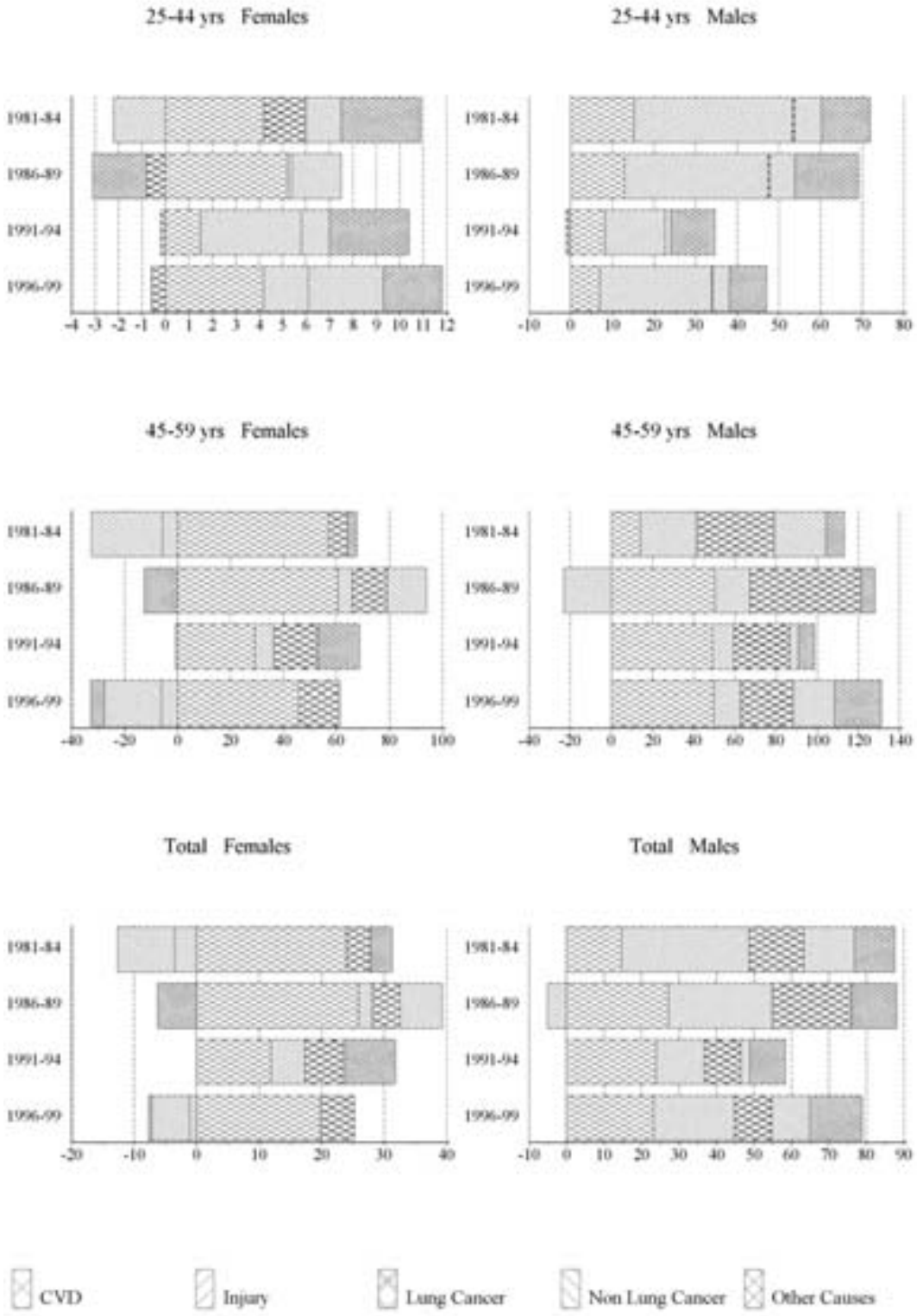
*age and ethnicity standardised
†per 100,000 person-years

Table 7-13 Manual / non-Manual SRR and SRD by Sex, Age, Cohort and Cause of Death - Males

Cause	Cohort	SRR (95%CI)*			SRD (95%CI)*†		
		Age			Age		
		25-44 yrs	45-59 yrs	Total	25-44 yrs	45-59 yrs	Total
All Causes	1981-84	1.63 (1.39- 1.91)	1.13 (1.03- 1.24)	1.22 (1.12- 1.32)	71.8 (49.7- 93.9)	113.1 (29.3- 197.0)	87.6 (52.8- 122.4)
	1986-89	1.66 (1.44- 1.92)	1.14 (1.04- 1.25)	1.24 (1.14- 1.34)	69.1 (50.1- 88.0)	105.1 (31.5- 178.6)	82.8 (52.4- 113.3)
	1991-94	1.29 (1.11- 1.50)	1.18 (1.05- 1.33)	1.21 (1.10- 1.33)	33.7 (13.8- 53.6)	98.4 (29.9- 166.9)	58.4 (29.5- 87.4)
	1996-99	1.48 (1.27- 1.73)	1.29 (1.15- 1.45)	1.34 (1.22- 1.47)	47.0 (28.2- 65.8)	130.8 (70.6- 191.0)	79.0 (53.3- 104.8)
CVD	1981-84	1.46 (1.07- 1.99)	1.03 (0.91- 1.17)	1.08 (0.96- 1.21)	15.2 (3.5- 26.8)	14.1 (-41.1- 69.3)	14.7 (-7.5- 37.0)
	1986-89	1.55 (1.13- 2.12)	1.14 (1.00- 1.30)	1.18 (1.05- 1.34)	12.9 (4.1- 21.8)	50.3 (1.7- 98.9)	27.2 (7.8- 46.6)
	1991-94	1.40 (1.02- 1.92)	1.21 (1.01- 1.45)	1.23 (1.05- 1.45)	8.3 (0.7- 16.0)	49.1 (2.2- 95.9)	23.9 (5.4- 42.4)
	1996-99	1.39 (1.01- 1.90)	1.30 (1.07- 1.58)	1.31 (1.11- 1.56)	7.0 (0.2- 13.7)	49.5 (12.8- 86.2)	23.2 (8.6- 37.9)
Lung Cancer	1981-84	1.17 (0.40- 3.43)	1.43 (0.99- 2.06)	1.42 (1.00- 2.02)	0.4 (-2.2- 2.9)	37.6 (2.3- 72.8)	14.6 (1.0- 28.2)
	1986-89	1.86 (0.41- 8.52)	2.00 (1.46- 2.74)	2.00 (1.47- 2.73)	0.5 (-0.8- 1.9)	54.2 (30.8- 77.7)	21.1 (12.1- 30.1)
	1991-94	0.54 (0.17- 1.74)	1.81 (1.21- 2.69)	1.69 (1.16- 2.47)	-1.0 (-2.7- 0.8)	27.0 (8.5- 45.5)	9.7 (2.6- 16.9)
	1996-99	1.39 (0.34- 5.66)	1.81 (1.19- 2.75)	1.79 (1.19- 2.70)	0.3 (-0.9- 1.4)	25.4 (7.6- 43.1)	9.9 (3.0- 16.7)
Non Lung Cancer	1981-84	1.30 (0.95- 1.79)	1.14 (0.94- 1.38)	1.16 (0.98- 1.38)	6.5 (-1.3- 14.3)	25.2 (-12.2- 62.6)	13.6 (-1.4- 28.7)
	1986-89	1.37 (0.98- 1.90)	0.89 (0.74- 1.07)	0.94 (0.80- 1.12)	6.0 (-0.3- 12.3)	-23.1 (-60.4- 14.3)	-5.1 (-19.9- 9.7)
	1991-94	1.07 (0.77- 1.48)	1.02 (0.83- 1.26)	1.03 (0.86- 1.24)	1.4 (-5.4- 8.2)	4.1 (-34.5- 42.7)	2.4 (-12.9- 17.7)
	1996-99	1.26 (0.89- 1.79)	1.12 (0.92- 1.37)	1.14 (0.95- 1.36)	4.0 (-2.1- 10.0)	20.2 (-15.4- 55.8)	10.2 (-4.0- 24.3)
Injury	1981-84	2.46 (1.77- 3.41)	2.08 (1.23- 3.51)	2.32 (1.75- 3.07)	38.1 (25.6- 50.5)	27.3 (10.2- 44.3)	33.9 (23.9- 44.0)
	1986-89	2.18 (1.66- 2.87)	1.60 (1.11- 2.31)	1.97 (1.58- 2.44)	34.4 (23.1- 45.6)	16.9 (3.9- 29.9)	27.7 (19.2- 36.2)
	1991-94	1.37 (1.02- 1.84)	1.55 (0.94- 2.54)	1.41 (1.10- 1.82)	14.4 (1.4- 27.3)	10.5 (-1.4- 22.3)	12.9 (3.6- 22.1)
	1996-99	2.25 (1.61- 3.14)	1.65 (0.93- 2.90)	2.03 (1.51- 2.72)	26.8 (15.8- 37.8)	13.2 (-1.2- 27.7)	21.6 (12.9- 30.3)

*age and ethnicity standardised
†per 100,000 person-years

Figure 7-10 Contribution of Causes to Manual-non-Manual SRD* for All-Cause Mortality, by age sex and cohort.



*age and ethnicity standardised per 100,000 person-years

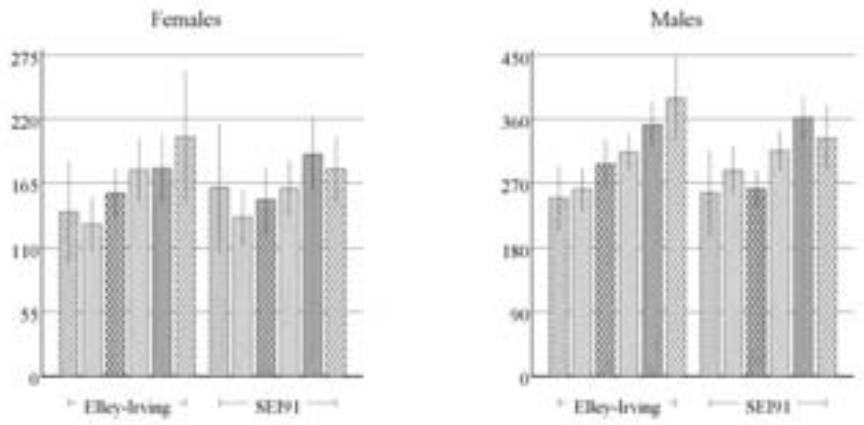
7.3. Assessment of Bias

7.3.1 Sensitivity to the Occupational Grouping

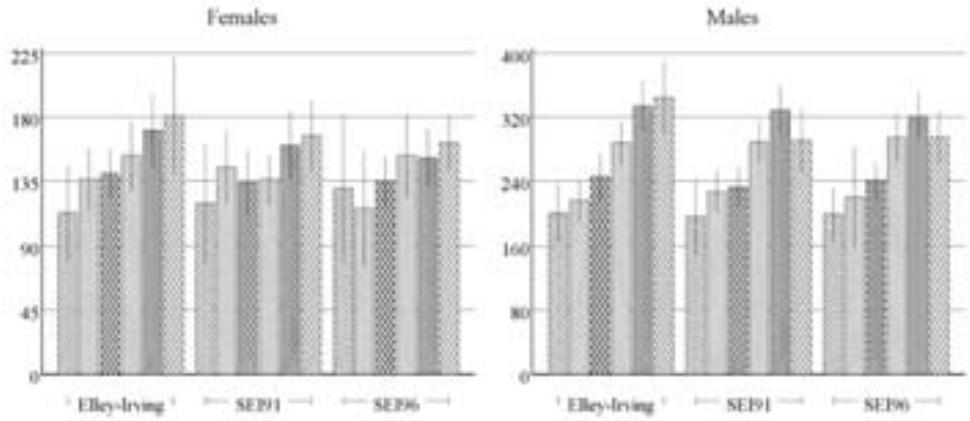
Figure 7-11 shows, for all cause mortality, mortality by occupational class using the different occupational class classifications for the 1991-94 and 1996-99 cohorts. The Elley-Irving scale produces a consistent monotonic relationship between social class and mortality rates for males which is not the case for either of the NZSEI scales.

Figure 7-11 Comparison of Performance of the year specific occupational classification[i] with the Elley-Irving Classification, all cause mortality, ages 25-59 years

(a) 1991



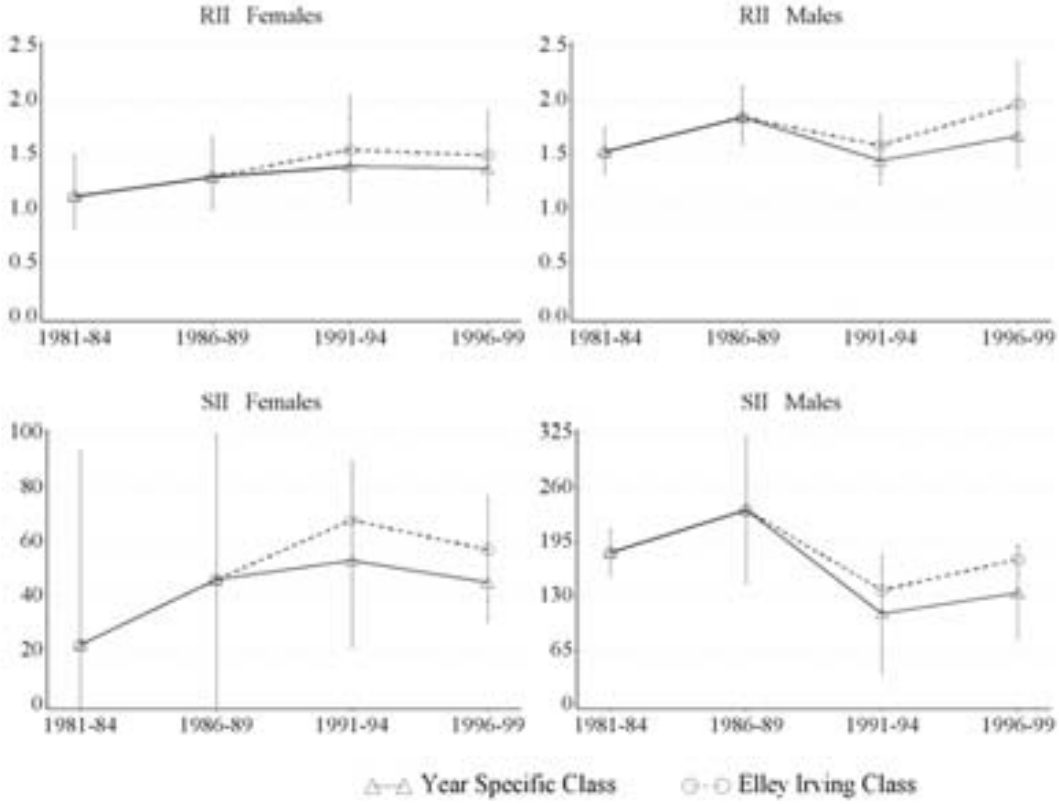
1996



[1] 1981-84 and 1986-89 Elley-Irving classification, 1991-94 NZSEI91 Classification, 1996-99 NZSEI96 classification

Figure 7-12 shows the impact on trends in the RII of using the Elley-Irving classification of occupations for all four cohorts compared to the period specific occupational classifications. Use of the year specific classifications produces lower RII and SII in the 1991-94 and 1996-99 cohorts. The use of the year specific scales thus leads to an underestimate of the increase in the RII and SII relative to the Elley-Irving scale.

Figure 7-12 Comparison of Trend in RII and SII for Elley-Irving Occupational Class and Year Specific Occupational Classifications*, All Cause Mortality, ages 25-59 years



* 1981-84 and 1986-89 Elley-Irving classification, 1991-94 NZSEI91 Classification, 1996-99 NZSEI96 classification

I decided to use the Elley-Irving classification because it I was able to produce a continuous series for the four cohorts. The SEI91 and SEI96 classifications were developed in response to a change in the occupational coding scheme. In these cohorts occupations were coded according to both the old task based classification (NZSCO68) and the more recent skill based classifications (NZSCO90 and NZSCO95). Differences between the year-specific classifications and the Elley-Irving scales come about both because of a change in the occupational coding and also differences in the methods by which the scales were derived.

7.3.2 Bias due to differential Health Selection Effects

The analyses in this chapter are limited to cohortees with a valid occupational class variable. Those without a valid variable account for around 40% of females and 20% of males in each cohort. Table 7-14 gives the SRR of those excluded from the analyses compared to those included. Cohortees excluded from the analyses had mortality rates substantially in excess of cohortees included in the analyses. The excess mortality was higher for males than females.

Table 7-14 SRR for all cause mortality. With:without current occupation by sex, age and cohort period.

Sex	Cohort Period	Age		
		25-44 yrs	45-59 yrs	Total
Females	1981-84	1.75 (1.51- 2.02)	1.85 (1.69- 2.04)	1.83 (1.69- 1.98)
	1986-89	1.63 (1.42- 1.87)	2.03 (1.84- 2.23)	1.93 (1.78- 2.08)
	1991-94	2.07 (1.80- 2.37)	2.02 (1.83- 2.23)	2.03 (1.87- 2.20)
	1996-99	1.95 (1.71- 2.22)	2.03 (1.85- 2.23)	2.01 (1.86- 2.17)
Males	1981-84	2.58 (2.23- 2.99)	2.20 (2.04- 2.37)	2.28 (2.14- 2.44)
	1986-89	3.21 (2.82- 3.66)	2.48 (2.31- 2.67)	2.65 (2.49- 2.83)
	1991-94	2.19 (1.96- 2.46)	2.28 (2.12- 2.45)	2.26 (2.12- 2.40)
	1996-99	1.89 (1.69- 2.13)	2.10 (1.95- 2.27)	2.04 (1.92- 2.18)

Given the changing proportion of the cohorts excluded with missing data it was possible that differential health selection from the active labour force as a result of illness would result in selection biases that varied by cohort. In order to assess possible health selection bias in each cohort the mortality rates and RII were adjusted using the method of Kunst and Mackenbach (Section 3.7.2.3, page 115).

Household Labour Force Survey (HLFS) data was used to determine the proportion of each class who were active and inactive. HLFS data are weighted to represent the New Zealand population. Cells with less than 1000 population are suppressed in all SNZ output. It was therefore only feasible to obtain proportions inactive and active for the combined 25-59 year age group. The proportion of each class who were inactive and the proportion of the inactive that were in each class by sex and year are given in Table 7-15, below. Both the proportion of each class that was inactive and the proportion of the inactive in each class were highest in the lowest occupational class (class 6).

Note that occupational codes available on the HLFS were the NZSCO68 in 1986, the NZCSC90 in 1991, and the NZSCO in 1996. Thus the results shown are for the year specific occupational class rather than the Elley-Irving classes

Table 7-15 Proportion of each class inactive and proportion of inactive in each class*, by sex and census period – ages 25-59 years

Sex	Class	Cohort Period					
		1986		1991		1996	
		Proportion of Class inactive	Proportion of Inactive in Class	Proportion of Class inactive	Proportion of Inactive in Class	Proportion of Class inactive	Proportion of Inactive in Class
Females	Class one	0.00	0.00	0.20	0.04	0.19	0.04
	Class two	0.29	0.14	0.22	0.09	0.22	0.10
	Class three	0.26	0.04	0.25	0.11	0.24	0.14
	Class four	0.28	0.02	0.31	0.20	0.28	0.20
	Class five	0.34	0.28	0.45	0.22	0.40	0.21
	Class six	0.42	0.52	0.52	0.34	0.43	0.31
Males	Class one	0.00	0.00	0.02	0.02	0.05	0.05
	Class two	0.04	0.13	0.05	0.06	0.02	0.03
	Class three	0.02	0.05	0.08	0.14	0.06	0.12
	Class four	0.00	0.00	0.15	0.28	0.12	0.26
	Class five	0.06	0.28	0.17	0.27	0.15	0.27
	Class six	0.09	0.53	0.15	0.24	0.17	0.27

*1981-84 and 1986-89 Elley-Irving classification, 1991-94 NZSEI91 Classification, 1996-99 NZSEI96 classification

The proportion of each class that was inactive was used to adjust the class specific mortality rates; adjusted rates are given in Table 7-16. As a result of the over-representation of class six in the inactive population the adjustments to the mortality rates for class six are greater than for class one.

Among females the effect of the adjustment was greatest in the earlier cohorts, while for men the effect was greatest in the later cohorts.

Table 7-16 Mortality rates* adjusted for the proportion inactive in each class†, by sex , cohort and cause of death – Females ages 25-59 years

Cohort	Class	Females						Males					
		All Causes		CVD		Cancer		All Causes		CVD		Cancer	
		Std Rate	Adjusted Rate	Std Rate	Adjusted Rate	Std Rate	Adjusted Rate	Std Rate	Adjusted Rate	Std Rate	Adjusted Rate	Std Rate	Adjusted Rate
1986-89	Class one	146.3	146.3	96.9	96.9	8.6	8.6	248.9	248.9	91.3	91.3	91.4	91.4
	Class two	188.5	240.1	96.8	111.9	55.6	74.9	317.6	338.2	98.0	102.4	131.0	137.1
	Class three	173.2	214.9	97.0	110.3	27.2	35.5	401.3	416.0	124.1	127.3	173.2	177.7
	Class four	167.2	211.0	90.7	104.2	37.8	50.4	394.3	394.3	118.2	118.2	153.9	153.9
	Class five	212.8	279.2	112.0	131.9	50.8	70.9	483.0	532.2	142.4	152.5	195.5	209.7
	Class six	216.6	300.7	110.5	134.9	72.8	108.7	490.5	566.8	126.6	140.3	209.8	233.2
1991-94	Class one	161.0	194.8	95.4	105.3	40.0	50.4	256.3	261.9	93.9	95.1	76.8	78.3
	Class two	135.4	166.5	80.8	90.0	30.9	39.7	287.5	305.6	113.0	117.3	100.9	106.6
	Class three	150.6	188.9	103.5	116.5	14.3	18.8	261.9	288.9	79.0	83.9	114.1	124.6
	Class four	160.0	210.7	95.7	110.7	31.4	43.8	315.8	373.5	95.0	105.5	119.0	138.5
	Class five	189.6	276.7	108.0	132.6	44.8	70.4	361.6	437.3	113.8	128.2	133.9	159.0
	Class six	177.3	271.5	107.5	135.8	36.1	59.9	333.2	396.0	112.3	125.1	123.9	144.8
1996-99	Class one	130.0	155.5	95.0	105.0	8.2	10.0	198.1	209.6	79.6	82.1	52.6	55.7
	Class two	115.7	141.3	91.9	102.8	13.6	17.0	219.8	225.5	85.7	86.9	55.1	56.5
	Class three	134.3	167.5	85.1	96.3	20.4	26.1	240.6	255.6	94.5	97.7	76.4	81.2
	Class four	152.8	196.5	102.1	117.7	25.7	34.0	294.9	332.6	105.4	112.7	91.5	103.2
	Class five	151.2	213.3	95.9	116.9	24.0	35.1	320.6	372.8	101.7	110.6	96.3	112.0
	Class six	161.6	232.6	97.0	119.8	37.6	56.2	294.9	348.9	101.4	111.4	107.1	126.7

*age and ethnicity standardised per 100,000 person-years
†1981-84 and 1986-89 Elley-Irving classification, 1991-94 NZSEI91 Classification, 1996-99 NZSEI96 classification

The RII is dependent on both the mortality rate and the class distribution of the population. The RII was recalculated to take account of the redistribution of the inactive cohort as well as the adjusted mortality rates. Adjusted RII and SII are given in Table 7-17, below. In all cases, except CVD for females in 1986-89 and 1991-94, the RII and SII increased as a consequence of the adjustment. For females, the RII for CVD decreased from 5.79 to 3.69 in 1986-89 and from 3.39 to 2.50 in 1991-94.

Table 7-17 RII and SII for Mortality by Occupational Class*, Adjusted for Proportion of Class Inactive, by sex, cohort, and cause– ages 25-59 years

Sex	Cohort	Cause of Death					
		All Causes		CVD		Cancer	
		RII†	Adjusted RII†	RII†	Adjusted RII†	RII†	Adjusted RII†
Females	1981-84	1.27	..	2.83	..	1.10	..
	1986-89	1.29	1.65	5.79	3.69	1.14	1.39
	1991-94	1.40	1.88	3.39	2.50	1.35	1.53
	1996-99	1.37	1.73	3.76	4.82	1.16	1.30
		SII†	Adjusted SII†	SII†	Adjusted SII†	SII†	Adjusted SII†
	1981-84	48	..	52	..	9	..
	1986-89	45	123	48	78	13	39
	1991-94	54	139	27	41	29	49
	1996-99	46	106	28	48	14	29
		RII†	Adjusted RII†	RII†	Adjusted RII†	RII†	Adjusted RII†
Males	1981-84	1.52	..	1.27	..	1.41	..
	1986-89	1.88	2.10	1.94	2.06	1.50	1.62
	1991-94	1.45	1.71	1.46	1.69	1.30	1.36
	1996-99	1.66	1.89	2.16	2.43	1.28	1.36
		SII†	Adjusted SII†	SII†	Adjusted SII†	SII†	Adjusted SII†
	1981-84	182	..	46	..	44	..
	1986-89	240	301	102	119	48	59
	1991-94	112	186	43	68	25	33
	1996-99	131	189	61	80	23	32

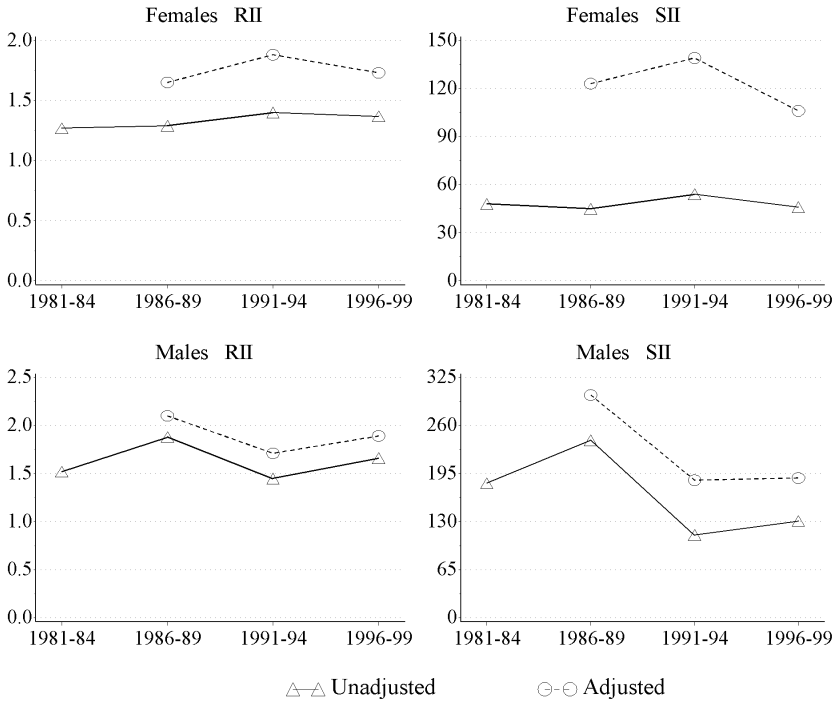
*1981-84 and 1986-89 Elley-Irving classification, 1991-94 NZSEI91 Classification, 1996-99 NZSEI96 classification. † age and ethnicity standardised

Although the size of the adjustments to the RII are large enough to bring into question the usefulness of occupational class analyses for examining trends in inequalities, these adjustments should be viewed as relatively extreme. The method used here to adjust for health selection relies on the assumption that the excess mortality among those without a

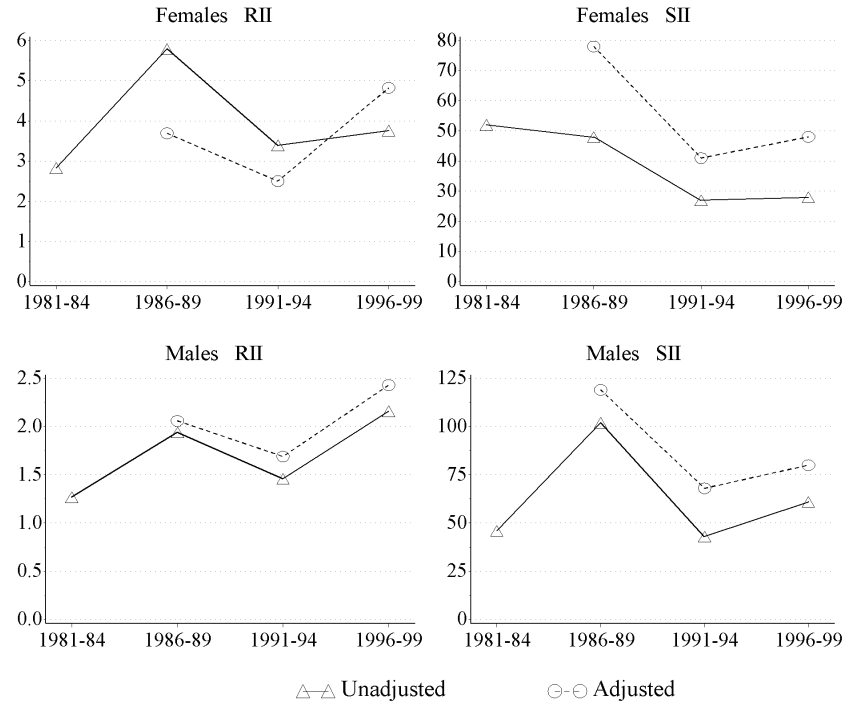
current occupation is the result of health selection out of the labour force. Two aspects of this assumption are questionable; first that lack of a current occupation is a result of illness; second that health selection explains all of the increased risk of mortality in those without a current occupation is in itself likely to be a risk factor for some illnesses.

Figure 7-13 Comparison of Unadjusted and Adjusted RII and SII by Sex, Cohort and Cause – ages 25-59 years

a. All Cause Mortality

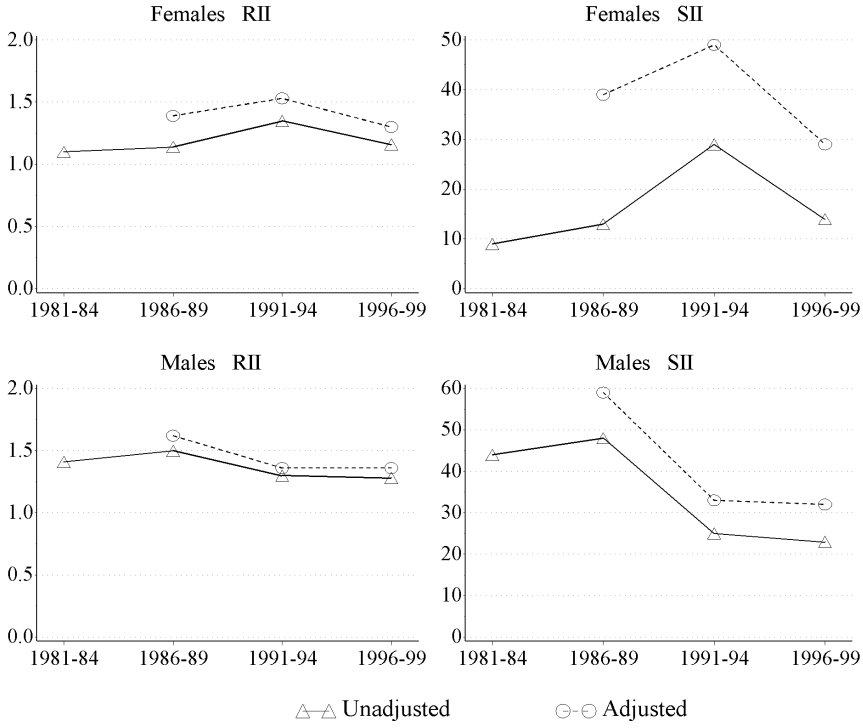


b. CVD



*age and ethnicity standardised

c. Cancer



*age and ethnicity standardised

Chapter 8 Effect Modification by Ethnicity

Text Box 7. Summary of Effect Modification by Ethnicity

Ethnicity is an independent determinant of both mortality and socioeconomic position. Thus ethnicity is a confounder of the association between socioeconomic position and mortality. Accordingly, ethnicity has been adjusted for in all other chapters of this thesis

The purpose of this Chapter is to determine whether the socio-economic mortality gradients reported elsewhere in this thesis, and trends in these gradients, apply equally to Mäori, Pacific and non-Mäori non-Pacific ethnic groups. In epidemiological terms, this Chapter explores possible effect measure modification of the association of socio-economic position with mortality by ethnicity.

Mortality rates by ethnicity and Socioeconomic Position.

Within levels of education, income and occupational class mortality rates for all cause mortality are higher for Māori than non-Māori non-Pacific. That is, ethnic differences in mortality are not explained by a single socio-economic factor (consistent with previous New Zealand research). Despite wide confidence intervals, in some cases, this pattern is consistent across all four cohorts for both men and women. Unfortunately due to sparse data the Pacific ethnic group could not be analysed separately.

Trends in Mortality rates by ethnicity within Socioeconomic groups.

In most instances trends in mortality rates by socio-economic group were similar by ethnicity. The main exceptions were:

Education: Whereas the non-Māori non-Pacific ethnic groups show declines in all cause mortality and CVD mortality at all education levels there is no consistent evidence that all cause mortality rates have declined at any level of education for Māori.

Income: Among females with high incomes, and males with high Mäori mortality rates increased while the mortality rates of the corresponding non-Mäori non-Pacific income group decreased.

Occupational Class: Mortality rates in non-manual occupations declined faster for Māori than for non-Māori non-Pacific cohortees.

Modification of low-high socio-economic position rate differences (SRD)

In almost all instances, low-high socioeconomic position rate differences for education, income and occupational class, for both all cause and CVD mortality, are higher for Māori than non-Māori non-Pacific.

Modification of trends ***in the low-high socio-economic position rate differences***

(SRD)

In general Trends in the SRD were too imprecise to distinguish differences by ethnicity. However there was a suggestion of some modification of the SRD in the following circumstances.

Low-high income SRD: among males only, the SRD for Māori decreased up until 1991-94 before increasing substantially in the last cohort, while the SRD for non-Māori non-Pacific were stable until 1991-94, but then decreased.

Manual-non-manual Occupational Class SRD: for males only, increased for Mäori but decreased for non-Mäori non-Pacific.

Modification of the low to high socio-economic position Rate Ratios (SRR)

There was no consistent pattern for SRR to be higher or lower for Māori compared to non-Māori non-Pacific for all cause mortality or CVD mortality.

Modification of trends ***for the low to high socio-economic position Rate Ratios (SRR)***

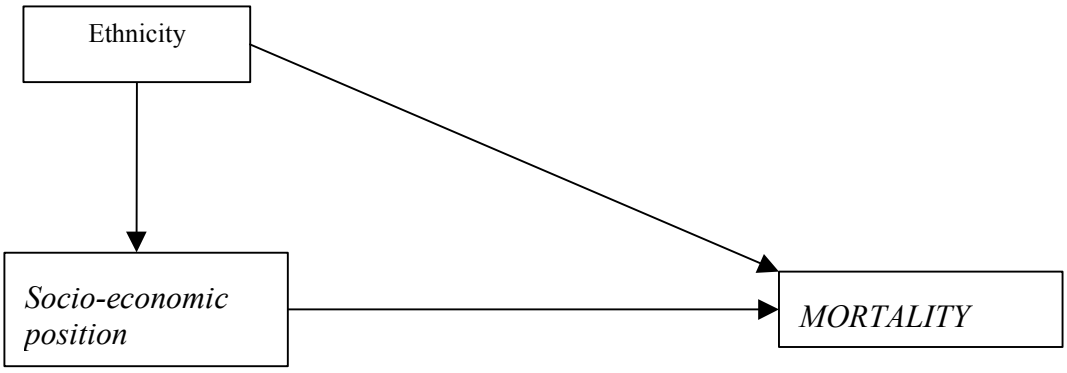
In general there was no clear evidence of modification of the SRR trend by ethnicity. The one possible exception was for the SRR for Low to High income, for females only; the low to high income SRR decreased over time for Māori females but increased for non-Māori non-Pacific females. Wide confidence intervals however limit the weight that should be given to this observation.

8.1. Background

Thus far results have been presented, standardised for both age and ethnicity. This chapter explores whether ethnicity is also a modifier of both the associations between ethnicity and mortality and the trends in mortality by socio-economic position.

There are substantial differences in mortality at each census, between Māori, Pacific Island and non-Māori non-Pacific ethnic (see section 4.4, page 127). Thus ethnicity is a major determinant of mortality. Ethnicity is also an important determinant of socio-economic position. In the presence of an association between ethnicity and socio-economic position ethnicity acts as a potential confounder of the association between socio-economic position and mortality.

Figure 8-1 Directed Acyclic Graph (DAG) showing conditions where ethnicity is a confounder of the relationship between socio-economic position and mortality.



For ethnicity to modify the relationship between socio-economic position and mortality, the relationship between socio-economic position and mortality must be different according to ethnicity. In addition to being of intrinsic interest such effect modification, such effect modification may also have an effect on the interpretation of results presented elsewhere in this thesis.

In the presence of effect modification standardisation by ethnicity will not control for the effect of ethnicity on inequality trends if the inequality trends are themselves modified by ethnicity. This is best explained by an example; consider a population comprised of two ethnic groups A and B, SRR and SRD are calculated using a standard population comprised 20% Group A and 80% Group B. Table 8-1 shows the RR and RD for high to low income

in the presence of effect modification that varies over time. Standardisation produces SRR and SRD estimates that are weighted by the ethnic composition of the standard population, but do not allow for the changing association of ethnicity and mortality by income level. In this example, the SRR and SRD are the same in the two periods for Group B but increase in the second period for group A. The ethnicity standardised SRR and SRD changes over the two periods as a result of the changing association in group A, but not group B. Thus the changes in the ethnicity standardised effect measures are a consequence of changes in the SRR and SRD for Group B only.

Table 8-1 Example of the Effect of Changing Effect Modification by Ethnicity on the Ethnicity SRD and SRR

Ethnic Group	% of standard population	RR		RD	
		Period 1	Period 2	Period 1	Period 2
Group A	20%	1.20	1.80	100	140
Group B	80%	1.50	1.50	150	150
		SRR		SRD	
		1.44	1.56	140	148

The Wald chi-square test for homogeneity is used as formal statistical test for modification of the point estimates of the SRR and SRD in each cohort in this chapter (methods section 3.6.5, page 111). As the standard population used a three-way classification of ethnicity, the test for homogeneity is applied across all three ethnic groupings – Māori, Pacific and non-Māori non-Pacific. (However data are too sparse to present for Pacific). On occasions, therefore, statistically significant tests of homogeneity may arise purely due to the Pacific group – I point out these occurrences.

In summary, this chapter provides a brief description of mortality rates by socio-economic position and ethnicity for each cohort, and considers the differences in trends in mortality rates and inequality measures by ethnicity. Given that this chapter involves multiple comparisons of effect measures by ethnicity and time period, over-emphasising a few results without reference to the general patterns could lead to spurious conclusions. I have taken a conservative approach and only draw a conclusion that effect modification exists where the evidence is strong.

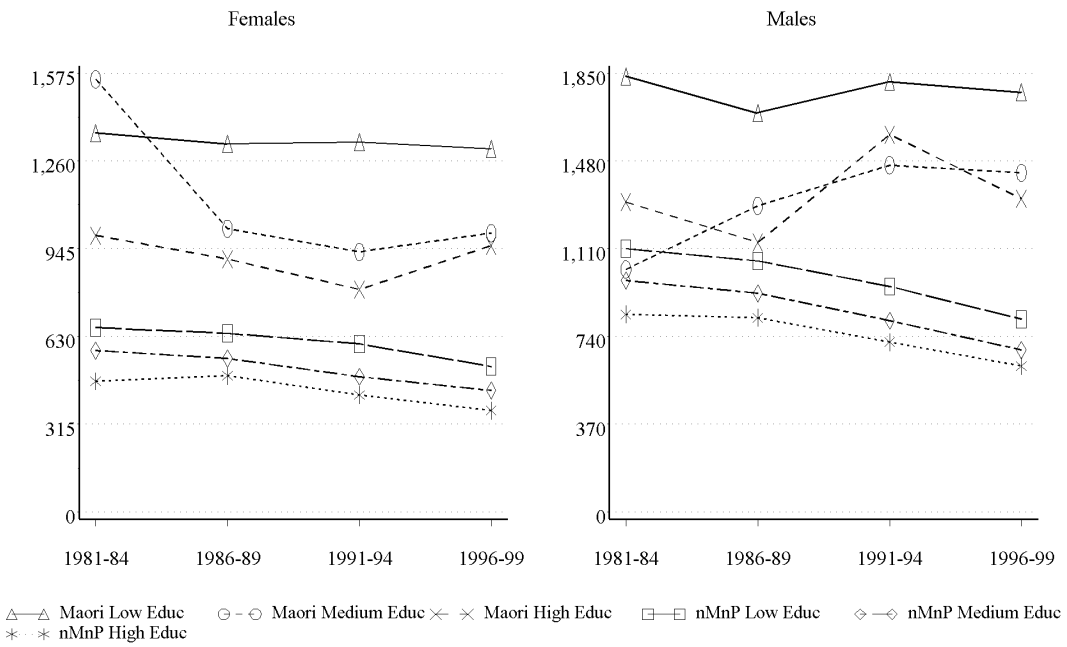
8.1.1 Ethnicity and Education Level

Table 8-2 and Table 8-3 give the number of deaths, standardised mortality rates, SRR and SRD by ethnicity and education level for all-causes and CVD. Low numbers of Māori deaths in the higher education levels in the earlier cohorts limit the interpretation of trends.

8.1.2 All cause mortality by education

Figure 8-2 shows that Māori mortality rates were higher than non-Māori at all levels of education, in each of the four cohorts. Confidence intervals around the mortality rates for Māori with high or medium qualifications are wide due to the small size of these population groups. Nevertheless the pattern of higher Mortality for Māori is consistent in all four cohorts.

Figure 8-2 All Cause Mortality Rates* by Ethnicity and Education Level, Māori and Non-Māori non-Pacific, Ages 25-77 Years, by Sex and Cohort.



*age standardised per 100,000 person-years

For the non-Māori non-Pacific group all-cause mortality rates declined by similar proportions for all education levels over the four cohorts. Furthermore mortality rates declined more, in percentage terms, for non-Māori non-Pacific than for their Māori counterparts.

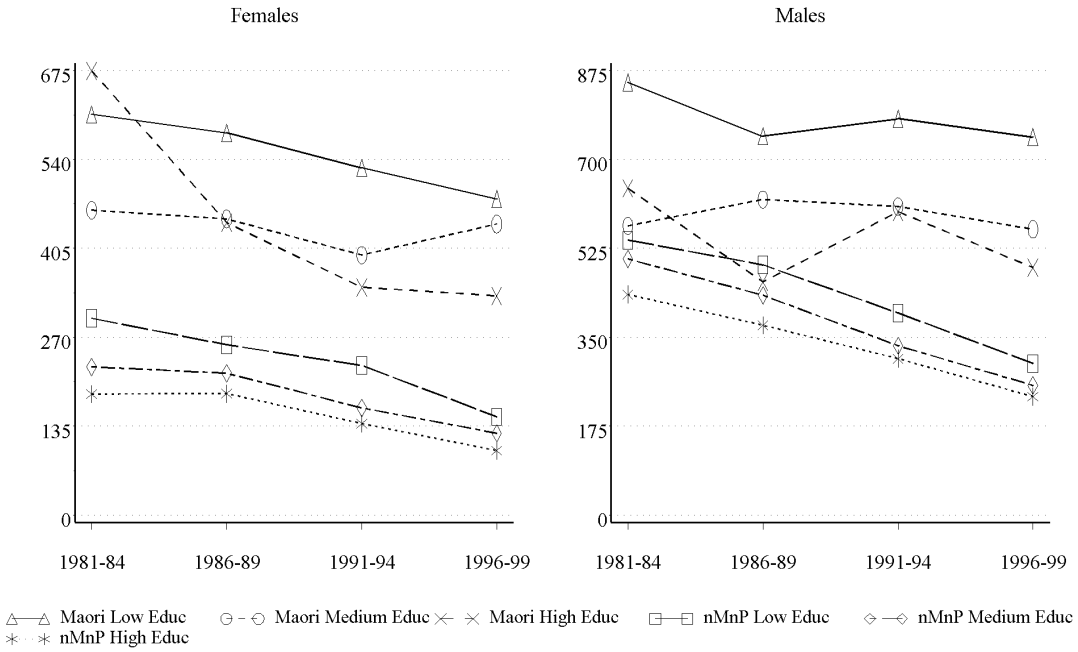
The Low-High education SRD, for Māori are two to three times greater than for non-Māori non-Pacific cohortees in each period for both males and females. The test for homogeneity yielded p-values less than 0.05 in the 1981-84 and 1991-96 cohorts for females and in the 1986-89 and 1996-99 cohorts for males. For Māori females the SRD was highest in the middle two cohorts; for non-Māori non-Pacific the SRD showed no particular pattern over time. Thus there is reasonable evidence that the SRD, within time periods, are heterogeneous by ethnicity but the same conclusion cannot be drawn about trends in the SRD.

The All-Cause low- to high-education SRR were similar for Māori or non-Māori non-Pacific and the confidence intervals, for Māori and non-Māori non-Pacific, overlap in each cohort, for both males and females. Trends in the SRR were relatively stable for non-Māori non-Pacific but for Māori the SRR increased consistently up until 1991-94 before decreasing in the last cohort. However, given the width of the confidence intervals I conclude that there is no support for heterogeneity of the SRR or of trends in the SRR.

8.1.3 CVD mortality by education

Figure 8-3 shows CVD mortality rates by ethnic group and three levels of education. Māori CVD mortality rates were higher than non-Māori non-Pacific rates at all levels of education, in each of the four cohorts. For the non-Māori non-Pacific group all educational levels experienced substantial declines in CVD mortality. Wide confidence intervals limit the interpretation of trends in mortality by education level for Māori females with high levels of education. CVD mortality rates did not decline as much for Māori males as their non-Māori non-Pacific counterparts. In conclusion there is strong evidence of heterogeneity of the mortality rates by ethnicity and some evidence, especially for males, of heterogeneity of mortality trends within education groups.

Figure 8-3 CVD Mortality Rates* by Ethnicity and Education Level, Māori and Non-Māori non-Pacific, Ages 25-77 Years, by Sex and Cohort.



*age standardised per 100,000 person-years

The SRD were higher for Māori than for non-Māori non-Pacific for both sexes in all periods, except females in 1981-84. However the test for homogeneity of the SRD, by ethnicity, yielded statistically significant p-values (less than 0.05) in 1996-99 (p=0.012), for males only. There was no consistent pattern for the SRR for CVD to be higher or lower for Māori compared to non-Māori non-Pacific. Confirming the general impression of homogeneity for the SRR by ethnicity tests for homogeneity by ethnicity of the SRR yielded p-values greater than 0.05 in all but one case - females in 1981-84 (p=0.04)

A large rise in the CVD SRR for Māori females arose out of large falls in the mortality rates for the high-education group. Confidence intervals were however wide and it is not possible to draw conclusions about differences by ethnicity in the trends in the SRR for CVD from these results.

Table 8-2 Change in mortality rates* by ethnicity and education level, Māori and non-Māori non-Pacific, ages 25-77 years – Females

Ethnicity	Education Level	1981-84				1986-89				1991-94				1996-99				% Change
		Deaths (n)†	Std Rate (95 % CI)			Deaths (n)†	Std Rate (95 % CI)			Deaths (n)†	Std Rate (95 % CI)			Deaths (n)†	Std Rate (95 % CI)			
All Causes																		
Māori	Low	1,179	1,361	(1,232	1,489)	1,194	1,321	(1209-	1,433)	1,386	1,328	(1,227	1,428)	1,560	1,304	(1,214	1,395)	-4%
	Medium	69	1,553	(454-	2,652)	117	1,017	(686-	1,348)	213	934	(759-	1,108)	414	1,001	(854-	1,148)	-36%
	High	57	993	(509-	1,476)	129	908	(652-	1,164)	207	799	(598-	999)	360	956	(788-	1,124)	-4%
	SRR (Low:High)		1.37	(0.83-	2.25)		1.46	(1.08-	1.95)		1.66	(1.28-	2.16)		1.36	(1.13-	1.65)	
	SRD (Low-High)		368	(-132-	868)		413	(134-	693)		529	(305-	753)		348	(157-	539)	
Non-M non-P	Low	9,750	662	(645-	678)	7,920	641	(624-	658)	6,234	603	(585-	621)	6,255	522	(507-	537)	-21%
	Medium	1,176	579	(535-	623)	2,292	551	(524-	578)	3,675	485	(467-	503)	2,886	436	(418-	454)	-25%
	High	1,293	469	(435-	503)	2,133	489	(462-	516)	2,502	420	(399-	440)	2,337	364	(346-	382)	-22%
	SRR (Low:High)		1.41	(1.31-	1.52)		1.31	(1.23-	1.39)		1.44	(1.36-	1.52)		1.43	(1.35-	1.52)	
	SRD (Low-High)		192	(155-	230)		152	(120-	184)		183	(156-	211)		158	(134-	181)	
p-value, SRR homogeneity			<0.01 ‡				0.76				**0.06**				0.26			
p-value, SRD homogeneity			<0.01 ‡				0.18				**<0.01**				0.10			
CVD																		
Māori	Low	483	609	(522-	695)	480	581	(502-	660)	510	527	(459-	596)	540	480	(424-	536)	-21%
	Medium	27	463	(139-	787)	36	450	(203-	697)	81	395	(277-	513)	141	442	(332-	552)	-5%
	High	27	674	(242-	1,107)	51	444	(249-	640)	75	346	(204-	487)	84	333	(220-	446)	-51%
	SRR (Low:High)		0.90	(0.47-	1.74)		1.31	(0.82-	2.07)		1.52	(0.99-	2.34)		1.44	(1.01-	2.07)	
	SRD (Low-High)		-66	(-507-	376)		137	(-74-	348)		181	(24-	339)		147	(21-	273)	
Non-M non-P	Low	4,413	299	(288-	310)	3,222	259	(248-	269)	2,304	227	(216-	238)	1,839	149	(141-	157)	-50%
	Medium	402	225	(197-	254)	861	215	(198-	233)	1,284	163	(152-	173)	783	124	(115-	134)	-45%
	High	432	184	(161-	207)	681	185	(167-	202)	684	139	(126-	152)	537	98	(88-	108)	-47%
	SRR (Low:High)		1.63	(1.43-	1.85)		1.4	(1.26-	1.55)		1.63	(1.47-	1.81)		1.53	(1.36-	1.71)	
	SRD (Low-High)		115	(90-	140)		74	(53-	95)		88	(71-	105)		51	(39-	64)	
p-value, SRR homogeneity			**0.04**				0.88				0.92				0.66			
p-value, SRD homogeneity			0.11				0.83				0.42				0.19			

*age standardised per 100,000 person-years †random rounded according to SNZ protocols ‡ p-value largely driven by estimates for the Pacific group.

Table 8-3 Change in mortality rates* by ethnicity and education level, Māori and non-Māori non-Pacific, ages 25-77 years – Males

Ethnicity	Education Level	1981-84 Deaths (n) †	1981-84 Std Rate (95 % CI)	1986-89 Deaths (n) †	1986-89 Std Rate (95 % CI)	1991-94 Deaths (n) †	1991-94 Std Rate (95 % CI)	1996-99 Deaths (n) †	1996-99 Std Rate (95 % CI)	% Change
All Causes										
Māori	Low	1,668	1,837 (1,702- 1,972)	1,461	1,683 (1,557- 1,809)	1,785	1,814 (1,693 - 1,936)	2,097	1,770 (1,667- 1,873)	-4%
	Medium	84	1,023 (614- 1,432)	198	1,291 (1,035- 1,546)	267	1,462 (1,224 - 1,699)	510	1,430 (1,258- 1,603)	40%
	High	123	1,307 (904- 1,709)	270	1,137 (922- 1,351)	489	1,592 (1,323 - 1,860)	624	1,321 (1,172- 1,470)	1%
	SRR (Low:High)		1.41 (1.02- 1.93)		1.48 (1.21- 1.81)		1.14 (0.95- 1.37)		1.34 (1.18- 1.52)	
	SRD (Low-High)		531 (106- 955)		546 (298- 795)		223 (-72- 517)		449 (268- 630)	
Non-M non-P	Low	14,304	1,110 (1,087- 1,133)	9,951	1,058 (1,033- 1083)	8,040	951 (926- 976)	8,295	813 (791- 835)	-27%
	Medium	2,145	976 (924- 1,028)	3,456	922 (886- 959)	4,473	807 (779- 834)	3,657	683 (658- 709)	-30%
	High	3,423	833 (797- 869)	6,576	819 (795- 843)	7,080	716 (696- 736)	5,889	615 (597- 633)	-26%
	SRR (Low:High)		1.33 (1.27- 1.40)		1.29 (1.24- 1.34)		1.33 (1.28- 1.38)		1.32 (1.27- 1.38)	
	SRD (Low-High)		277 (234- 319)		239 (205- 274)		235 (203- 267)		198 (169- 226)	
p-value, SRR homogeneity			0.48		0.29		**0.05**		0.92	
p-value, SRD homogeneity			0.34		**0.04**		0.40		**0.01**	
CVD										
Māori	Low	771	852 (763- 941)	630	746 (659- 833)	771	780 (703- 858)	843	744 (676- 813)	-13%
	Medium	30	569 (247- 892)	90	621 (443- 799)	108	607 (459- 756)	198	563 (456- 670)	-1%
	High	48	643 (335- 952)	96	459 (313- 605)	192	597 (458- 736)	228	487 (403- 571)	-24%
	SRR (Low:High)		1.32 (0.81- 2.16)		1.63 (1.16- 2.28)		1.31 (1.01- 1.68)		1.53 (1.26- 1.86)	
	SRD (Low-High)		209 (-113- 530)		287 (117- 457)		183 (24- 342)		257 (149- 366)	
Non-M non-P	Low	7,173	541 (526- 556)	4,764	492 (476- 509)	3,477	398 (383- 413)	3,201	299 (287- 311)	-45%
	Medium	1,059	504 (466- 542)	1,614	433 (408- 457)	1,896	333 (316- 351)	1,347	255 (240- 271)	-49%
	High	1,674	434 (408- 461)	2,928	374 (357- 390)	2,973	308 (295- 321)	2,166	233 (222- 244)	-46%
	SRR (Low:High)		1.25 (1.17- 1.33)		1.32 (1.25- 1.39)		1.29 (1.22- 1.37)		1.28 (1.20- 1.36)	
	SRD (Low-High)		107 (77- 138)		119 (96- 142)		90 (70- 110)		65 (49- 82)	
p-value, SRR homogeneity			0.37		0.31		0.52		0.14	
p-value, SRD homogeneity			0.47		0.11		0.33		**<0.01**	

*age standardised per 100,000 person-years †random rounded according to SNZ protocols

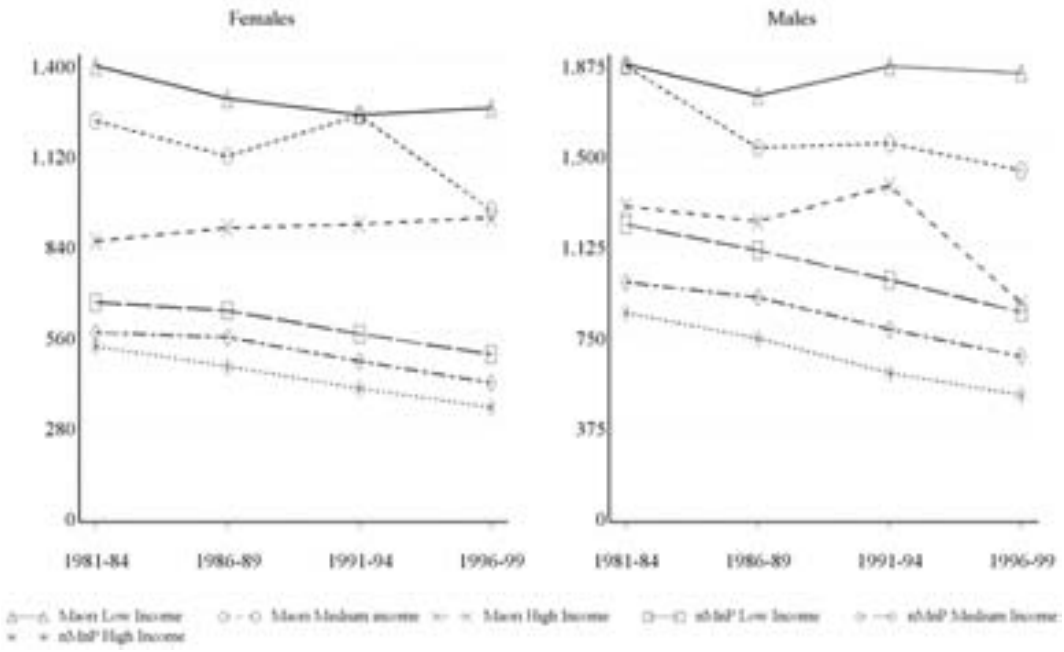
8.2. Income Trends

Table 8-4 and Table 8-5 give number of deaths, standardised mortality rates, SRR and SRD by ethnicity and income level for all-causes and CVD.

8.2.1 All cause mortality by income

Figure 8-4 shows all cause mortality rates by levels of income for Māori and non-Māori non-Pacific cohortees. Māori mortality rates were higher than non-Māori at all income levels, in each of the four cohorts.

Figure 8-4 All Cause Mortality Rates* by Ethnicity and Income Level, Māori and Non-Māori Non-Pacific, 25-77 Years



*age standardised per 100,000 person-years

Examination of trends in mortality rates by income levels (Figure 8-4) shows that high and medium income Mäori males experienced strong declines in mortality rates. However this was not the case for low-income Mäori males, or Mäori females in all income groups, who experienced little, if any, decline in mortality rates over the four cohorts. The non-Mäori non-Pacific group experienced strong decreases in mortality at all levels of income. Thus

there is strong evidence of effect modification of mortality trends among low-income males, and among females in all income levels.

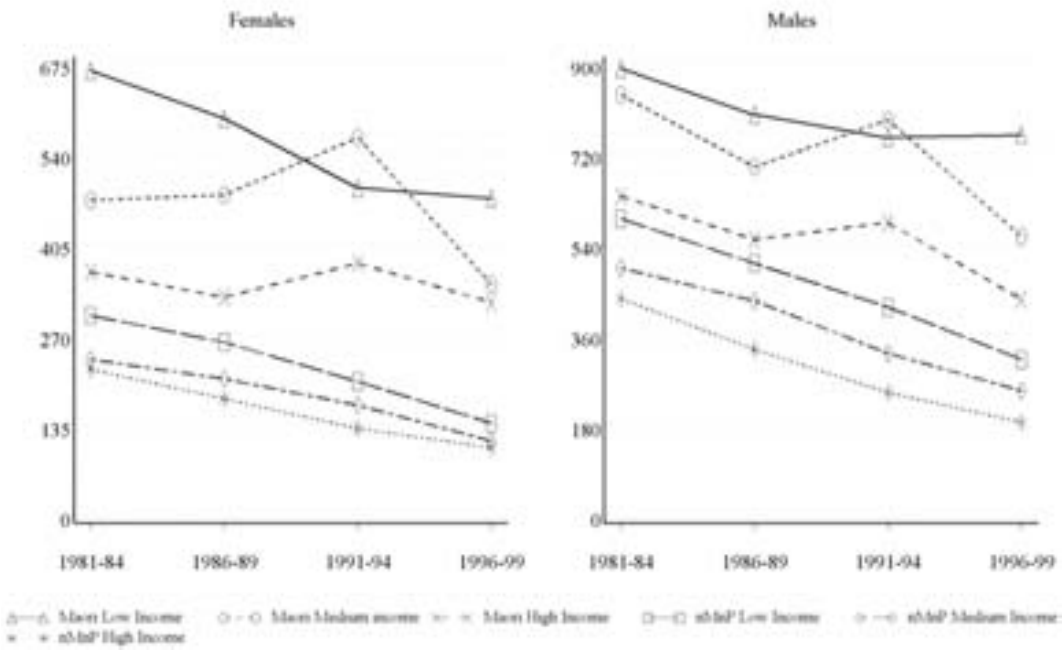
In each period the SRD for Māori were consistently higher than the SRD for non-Māori non-Pacific. Tests for homogeneity yielded p-values less than 0.05 in only one of the four cohorts, but approaching 0.05 in one other, for both males and females. For females, both Māori and non-Māori non-Pacific, SRD in the later cohorts are less than in the earlier cohorts. In contrast for males, SRD for Māori decreased up until 1991-94 before increasing substantially in the last cohort, while the SRD for non-Māori non-Pacific males were stable until 1991-94, but then decreased. Whilst confidence intervals were wide, this deviation of SRD trends in the late 1990s is intriguing.

There was no particular pattern for the SRR for Māori to be less or greater than those for non-Māori non-Pacific. For Māori females, there was a tendency for the SRR by income level to decrease over time while for non-Māori non-Pacific the SRR increased but confidence intervals of the SRR overlapped in all four cohorts. In contrast for males the SRR increased for both Māori and non-Māori non-Pacific. To assess whether the SRR trends were significant for females I ran a test of trend on the log of the SRR for Mäori and non-Mäori females – this produced p-value of 0.07 for Mäori and 0.02 for non-Mäori non-Pacific. Overall I therefore conclude that there is some evidence of effect modification of the trend in SRR for females but not males.

8.2.2 CVD mortality by income

Figure 8-5 gives CVD mortality rates by income for Māori and non-Māori non-Pacific cohortees. Māori mortality rates are two to three times rates for non-Māori non-Pacific of a similar income level. At the same time while CVD mortality declined at slower rate for Māori than for non-Māori non-Pacific. Among non-Māori non-Pacific cohortees the rate of decline in CVD mortality was similar (approximately 50%) for all income groups. In contrast for Māori the proportionate decline in CVD mortality was greatest for the lowest income group (29%) and least in the highest income group (13%). Thus there is evidence of some difference by ethnicity in the extent of downward trend in mortality by income. The trend is however towards a decrease in CVD mortality for all groups except high-income Māori females.

Figure 8-5 CVD Mortality Rates* by Ethnicity and Income Level, Māori and Non-Māori Non-Pacific, Ages 25-59 Years



*age standardised per 100,000 person-years

As with all-cause mortality, CVD SRD for Māori are greater than those for non-Māori non-Pacific. The SRD for both Māori and non-Mäori non-Pacific females decreases across the four cohorts. For males, both Māori and non-Māori non-Pacific SRD are relatively stable until 1991-94 but in 1996-99 non-Māori non-Pacific SRD decreased (confidence intervals for 1991-94 and 1996-99 do not overlap) and for Māori may even increase. Thus there is some evidence for heterogeneity of the trend in the SRD for males but only over the last two cohorts.

As with all cause mortality there was no particular pattern for the CVD SRR for Māori to be less or greater than those for non-Māori non-Pacific. Confidence intervals around the SRR were too wide to differentiate with any certainty differences in trends by ethnicity for either males or females.

Table 8-4 Change in mortality rates* by Ethnicity and Income , Māori and non-Māori non-Pacific, ages 25-77 years - Females

Income Level	1981-84		1986-89		1991-94		1996-99	
	Deaths (n)†	Std Rate (95% CI)	Deaths (n)†	Std Rate (95% CI)	Deaths (n)†	Std Rate (95% CI)	Deaths (n)†	Std Rate (95%
Low	648	1,387 (1,231- 1,542)	720	1,286 (1,160- 1,412)	993	1,236 (1,132- 1,341)	1,110	1,257 (1,159-
Medium	261	1,217 (957- 1,477)	348	1,108 (912- 1,303)	339	1,234 (1,023- 1,445)	363	940 (795-
High	150	845 (573- 1,117)	126	886 (545- 1,227)	135	897 (574- 1,220)	222	918 (643-
High)		1.64 (1.17- 2.31)		1.45 (0.98- 2.16)		1.38 (0.95- 1.99)		1.37 (1.00-
-High)		542 (229- 855)		400 (37- 764)		339 (-1- 678)		339 (47-
n- Low	6,030	656 (635- 678)	6,486	630 (611- 650)	6,564	558 (541- 575)	5,589	496 (480-
Medium	2,511	562 (534- 590)	3,630	548 (526- 570)	2,487	474 (452- 496)	2,286	407 (388-
High	2,445	519 (489- 549)	1,998	458 (430- 486)	2,052	390 (367- 412)	1,746	331 (309-
High)		1.26 (1.18- 1.35)		1.38 (1.29- 1.48)		1.43 (1.34- 1.53)		1.50 (1.39-
-High)		137 (100- 174)		173 (138- 207)		168 (140- 196)		165 (138-
R homogeneity		0.22		**0.07**		0.82		0.84
D homogeneity		**0.03**		0.13		0.30		0.24
Low	276	664 (549- 780)	297	593 (502- 685)	372	490 (420- 559)	384	474 (410-
Medium	102	471 (322- 620)	144	479 (347- 611)	126	564 (405- 724)	117	346 (252-
High	60	364 (206- 521)	48	326 (169- 483)	45	377 (162- 591)	48	318 (125-
High)		1.83 (1.14- 2.91)		1.82 (1.10- 3.01)		1.30 (0.72- 2.34)		1.49 (0.80-
-High)		300 (105- 496)		267 (86- 449)		113 (-112- 338)		156 (-48-
n- Low	2,934	299 (285- 313)	2,880	259 (247- 271)	2,541	200 (191- 210)	1,665	138 (130-
Medium	957	233 (214- 252)	1,302	204 (191- 218)	801	165 (152- 179)	609	111 (101-
High	870	218 (197- 240)	603	175 (156- 194)	537	130 (116- 144)	366	102 (88-
High)		1.37 (1.23- 1.53)		1.48 (1.32- 1.67)		1.54 (1.37- 1.73)		1.36 (1.18-
-High)		81 (55- 106)		84 (62- 107)		70 (53- 87)		37 (21-
R homogeneity		0.43		**0.08**		0.84		0.78
D homogeneity		0.09		**0.05**		0.62		0.15

*age standardised per 100,000 person-years †random rounded according to SNZ protocols

Table 8-5 Change in mortality rates* by Ethnicity and Income, Māori and non-Māori non-Pacific, ages 25—77 years - Males

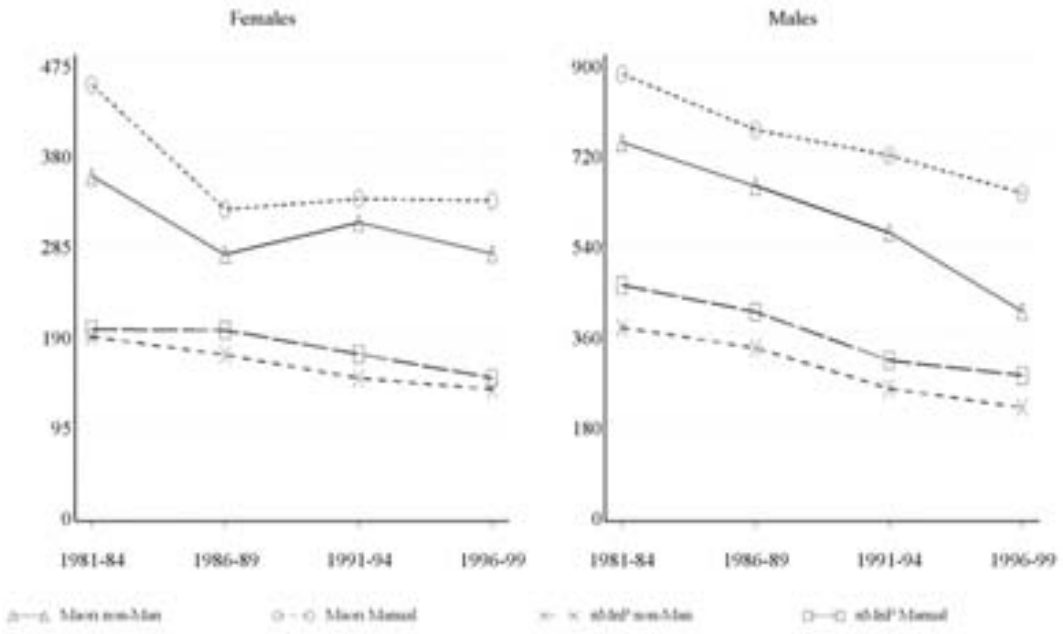
Ethnicity	Income Level	1981-84		1986-89		1991-94	
		Deaths (n)†	Std Rate (95% CI)	Deaths (n)†	Std Rate (95% CI)	Deaths (n)†	Std Rate (95%
All Causes							
Māori	Low	786	1,864 (1,683- 2,045)	819	1,734 (1,577- 1,891)	1,293	1,856 (1,720-
	Medium	408	1,857 (1,521- 2,192)	567	1,518 (1,325- 1,712)	492	1,537 (1,308-
	High	285	1,276 (1,009- 1,544)	252	1,214 (925- 1,503)	255	1,361 (976-
SRR (Low:High)			1.46 (1.16- 1.84)		1.43 (1.11- 1.84)		1.36 (1.02-
SRD (Low-High)			588 (265- 910)		520 (191- 849)		495 (87-
non-M non-P	Low	8,415	1,200 (1,166- 1,234)	8,922	1,094 (1,064- 1,123)	9,492	970 (945-
	Medium	4,440	961 (926- 997)	6,000	899 (871- 926)	4,176	767 (739-
	High	4,785	835 (802- 868)	3,999	729 (698- 760)	3,612	586 (561-
SRR (Low:High)			1.44 (1.37- 1.51)		1.50 (1.43- 1.58)		1.66 (1.58-
SRD (Low-High)			365 (318- 413)		365 (322- 408)		385 (349-
p-value, SRR homogeneity			0.23		0.89		<0.01 ‡
p-value, SRD homogeneity			**0.08**		0.59		**0.06**
CVD							
Māori	Low	363	890 (764- 1,016)	363	799 (688- 910)	516	753 (668-
	Medium	183	838 (638- 1,039)	240	694 (553- 835)	237	788 (634-
	High	123	636 (421- 851)	111	550 (357- 743)	114	584 (344-
SRR (Low:High)			1.40 (0.97- 2.02)		1.45 (1.00- 2.12)		1.29 (0.84-
SRD (Low-High)			254 (5- 504)		249 (26- 471)		169 (-85-
Non-M non-P	Low	4,341	591 (568- 614)	4,308	502 (483- 521)	4,293	415 (400-
	Medium	2,238	493 (468- 518)	2,871	428 (409- 446)	1,746	323 (306-
	High	2,367	432 (407- 456)	1,767	331 (310- 352)	1,413	245 (229-
SRR (Low:High)			1.37 (1.28- 1.47)		1.52 (1.41- 1.64)		1.69 (1.57-
SRD (Low-High)			159 (126- 193)		171 (143- 200)		170 (147-
p-value, SRR homogeneity			**0.09**		0.80		<0.01 ‡
p-value, SRD homogeneity			0.12		0.78		**0.10**

*age standardised per 100,000 person-years †random rounded according to SNZ protocols ‡ p-value largely driven by estimates for the Pacific group

8.3. Occupational Class Trends

Table 8-6 gives mortality rates for non-manual and manual occupational groups for Māori and non-Māori non-Pacific ethnic groups. Figure 8-5 shows mortality rates by occupational group and cohort for males and females. Mortality rates were two to three times higher for Māori than non-Māori non-Pacific in each occupational class.

Figure 8-6 All Cause Mortality Rates* by Ethnicity and Occupational Class, Māori and non-Māori non-Pacific, Ages 25-59 Years



*age standardised per 100,000 person-years

Among females, both Mäori and non-Mäori non-Pacific manual classes experienced a 27% decline in mortality but for non-Manual classes the decrease in mortality between 1981-84 and 1996-99 was less for Māori than for non-Māori non-Pacific. In contrast for males, while trends in mortality for non-manual classes are similar for both ethnic groups, mortality rates for manual classes decline much more, in percentage terms, for non-Māori non-Pacific than for Māori males.

In all cohorts Manual-non-Manual SRD are greater for Māori than for non-Māori non-Pacific. The tests for homogeneity yields p-values greater than 0.05 in all periods except for

in 1996-99 for males only (p-value=0.03). Confidence Intervals are too wide to discriminate between trends in the SRD for Māori compared to non-Māori non-Pacific females but among males, the SRD almost doubles for Māori over the four cohorts, while decreasing slightly for non-Māori non-Pacific males.

The SRR shows no particular pattern by ethnicity. The trend in the SRR was however similar for Māori and non-Māori non-Pacific, with both showing relatively stable SRR up until 1991-94 and then increasing in 1996-99.

Table 8-6 All Cause Mortality Rates* by Ethnicity and Occupational Class, Māori and non-Māori non-Pacific, ages 25-59 years, by Sex.

Sex	Ethnicity	Occupational Class	1981-84		1986-89		1991-94		1996-99		% Change
			Deaths (n)†	Std Rate (95% CI)	Deaths (n)†	Std Rate (95% CI)	Deaths (n)†	Std Rate (95% CI)	Deaths (n)†	Std Rate (95% CI)	
Females	Māori	Non-Manual	78	355 (190- 519)	90	273 (173- 372)	105	306 (205- 407)	174	274 (202- 346)	-23%
		Manual	174	451 (342- 560)	150	320 (243- 396)	117	331 (242- 419)	156	329 (244- 414)	-27%
		SRR (Low:High)		1.27 (0.75- 2.15)		1.17 (0.76- 1.82)		1.08 (0.71- 1.65)		1.20 (0.83- 1.74)	
		SRD (Low-High)		96 (-101- 294)		47 (-79- 173)		25 (-110- 159)		55 (-56- 166)	
	non-M non-P	Non-Manual	1,023	186 (169- 202)	1,107	167 (152- 182)	1,095	142 (130- 155)	1,191	131 (120- 142)	-30%
		Manual	429	194 (168- 219)	384	193 (164- 221)	324	168 (141- 194)	357	142 (121- 163)	-27%
		SRR (Low:High)		1.04 (0.89- 1.22)		1.15 (0.97- 1.37)		1.18 (0.98- 1.41)		1.09 (0.92- 1.29)	
		SRD (Low-High)		8 (-23- 38)		26 (-6- 58)		25 (-5- 55)		12 (-12- 35)	
p-value, SRR homogeneity				0.72		0.28		0.12		0.45	
p-value, SRD homogeneity				0.59		0.21		0.29		0.36	
Males	Māori	Non-Manual	114	739 (474- 1004)	126	653 (453- 852)	162	560 (407- 713)	186	403 (307- 500)	-45%
		Manual	612	875 (750- 1001)	645	764 (669- 860)	426	713 (596- 831)	510	638 (543- 734)	-27%
		SRR (Low:High)		1.18 (0.81- 1.74)		1.17 (0.84- 1.63)		1.27 (0.93- 1.75)		1.58 (1.19- 2.10)	
		SRD (Low-High)		136 (-157- 429)		112 (-109- 333)		153 (-40- 346)		235 (99- 371)	
	non-M non-P	Non-Manual	2,208	370 (349- 392)	2,079	330 (310- 349)	1,665	249 (232- 266)	1,560	211 (196- 227)	-43%
		Manual	2,820	455 (432- 478)	2,439	402 (380- 423)	1,581	305 (284- 326)	1,425	275 (255- 295)	-40%
		SRR (Low:High)		1.23 (1.14- 1.33)		1.22 (1.12- 1.32)		1.22 (1.11- 1.35)		1.30 (1.17- 1.44)	
		SRD (Low-High)		84 (53- 116)		72 (43- 101)		56 (29- 83)		64 (38- 89)	
p-value, SRR homogeneity				0.81		0.60		0.52		0.44	
p-value, SRD homogeneity				0.77		0.40		0.44		**0.03**	

*age standardised per 100,000 person-years †random rounded according to SNZ protocols

8.4. Implications for this thesis

The results of this chapter show that within levels of education, income and occupational class mortality rates for all cause mortality are higher for Māori than non-Māori non-Pacific. That is, ethnic differences in mortality are not explained by a single socio-economic factor (consistent with previous New Zealand research). Despite wide confidence intervals, in some cases, this pattern is consistent across all four cohorts for both men and women, for both all cause and CVD mortality.

In the presence of substantial mortality differences by ethnicity, there must be modification by ethnicity of either the absolute (SRD) or the relative (SRR) effect measure. The results in this chapter show a general pattern of similar SRR by ethnic group but differing SRD. That is at any point in time the results presented here provide reasonably consistent evidence that there is little, if any, modification of the relative effect measures by ethnicity but reasonably consistent evidence that absolute effect measures are modified by ethnicity.

Trends in the relative effect measures arise from the different trends in mortality within socio-economic groups. The results here suggest that on the whole trends in mortality rates for each socioeconomic group are similar for Maori and non-Maori non-Pacific and as a consequence so are trends in the SRR and SRD. However there are a few instances where effect modification of mortality trends by ethnicity may explain part of observed trends in the age and ethnicity standardised effect measures.

This is particularly the case for trends in absolute effect measures. In particular by income the age and ethnicity standardised rate differences by income are fairly stable, however this stability hides a divergence of trends by ethnicity over the later cohorts, whereby SRD for non-Maori non-Pacific decline but SRD for Maori increase. Similarly by occupation the age and ethnicity standardised results suggest that absolute inequality is fairly stable over the cohorts but the manual-non-Manual SRD increases for Maori while decreasing for non-Maori non-Pacific.

Chapter 9 International Comparisons

Text Box 8. Summary re International Comparisons

Background

The following chapter comprises the submitted version of a paper comparing trends in educational inequalities in New Zealand with trends in Finland, Denmark and Norway.

ABSTRACT

During the 1980s and early 1990s New Zealand experienced major social and economic change, decreasing all-cause mortality rates for the majority ethnic group, and high (but falling) cardiovascular disease (CVD) mortality rates. This paper explores whether inequalities in mortality by education were greater, and increased more, in New Zealand than in Nordic countries (Denmark, Finland and Norway), and determines the contribution of CVD to these differences and trends.

METHODS: We used mortality rates for 30-59 year olds by education, and the slope (SII) and relative (RII) indices of inequality, calculated from comparable linked census-mortality data.

RESULTS Mortality inequalities in New Zealand were at the high end of the European range when standardised by age only, but were mid-range when also standardised by ethnicity

Over time, *relative* inequalities in all-cause mortality increased similarly in all countries. In New Zealand a large increase in inequality for CVD mortality was the major contributor. In contrast but both CVD and other causes of death were important drivers of increasing inequalities in Nordic countries. *Absolute* inequalities in all-cause mortality were stable over time among males across all countries, and increased modestly among females. The contribution of CVD to absolute inequality was stable or decreasing over time in all countries.

CONCLUSION Overall, inequalities in mortality in New Zealand do not seem to have widened more rapidly than in northern European countries. However, rapid social and economic change may have affected trends in CVD mortality among low educated men and women, and especially the ethnic minority groups.

9.1. Introduction

The following chapter comprises the submitted version of a paper comparing trends in educational inequalities in New Zealand with trends in Finland, Denmark and Norway.

Initially a broader group of European countries were considered for the analysis. However the European countries included in these comparisons were limited to three based on the comparability of the data. Lack of comparability in the educational classifications and the age ranges for which data were available were the deciding factors in this choice.

Comparisons based on occupational class were available. However, as reported in Chapter 7 the usefulness of the New Zealand data for comparisons of trends over time are limited by the proportion of records with no current occupation.

As lead author of this paper I undertook all analytical work and wrote the paper. Anton Kunst assisted with access to the European data and with suggestions for the structure and content of the paper. Tony Blakely also assisted with comments on the content of the paper.

Are mortality differences and trends by education any better or worse in New Zealand? A comparison study of Norway, Sweden, Finland and New Zealand, 1980-90s.

Authors: Jackie Fawcett, Tony Blakely, Anton Kunst

9.2. Background

Socio-economic inequalities in mortality seem to be inexorably increasing in Western Europe (Borrell et al. 1997; Harding 1995; Lang and Ducimetiere 1995; Mackenbach et al. 2003; Martikainen et al. 2001b; Regidor et al. 1995; Valkonen et al. 2000) and the United States (Schalick et al. 2000) – in relative terms at least. Does this trend vary by the macroeconomic, social and political context (and in particular changing context) of different countries? Are these trends explained solely by the changing socioeconomic distribution of cardiovascular disease? And what difference does it make if you look at absolute inequalities in addition to relative inequalities? We attempt to probe these questions further in this paper by bringing New Zealand into a cross-national comparison with Nordic countries. New Zealand has a number of features that add an extra dimension of desirable variation to cross-national comparisons – particularly during the 1980s and 1990s.

(1) Social and economic change in New Zealand during the 1980s and 1990s

New Zealand society changed dramatically in the 1980s and 1990s, with 1984 often identified as the major turning point. Faced with huge social and economic challenges consequent to, a decade of tight economic regulation of the New Zealand economy, rapidly declining terms of trade and double-digit inflation, the New Zealand government responded with a radical restructuring of state social welfare system from the mid 1980s onwards (Belich 2001). In particular: privatisation of major utilities and government services; a substantially flattened tax system; the introduction of a consumption tax, the introduction of market rentals for social housing; user charges for health, education and other government services; and a restructured labour market all contributed to major social change (Belich 2001; Boston et al. 1999). Unemployment peaked in 1992 at 11% before declining in the late 1990s(Statistics New Zealand 1999b). Income inequality, as measured by the gini-coefficient, increased by 20% from 0.26 to 0.31 between 1982 and 1997 (Mowbray 2001).

The radical social change in New Zealand contrasts with the smoother social adjustments made to economic crises that occurred from the early 1990s in Finland and other Nordic countries (Esping-Andersen 1999). Cross-national comparison studies across Europe have, perhaps somewhat surprisingly, shown that substantial inequalities exist even in countries with relatively egalitarian social policies and free health services (Kunst 1997; Kunst et al. 1998a; Kunst et al. 1999; Kunst et al. 1998b; Kunst et al. 1998c; Kunst et al. 1998d). A central question, therefore, of this paper is whether the rapid social and economic reforms in New Zealand were associated with a more pronounced widening of mortality inequalities than in Nordic countries.

Both ethnicity and socio-economic position matter as determinants of health in New Zealand

In New Zealand socioeconomic gradients in mortality exist according to a wide variety of socioeconomic measures (Bell et al. 1996; Blakely et al. 2002b; Crampton 1997; Pearce et al. 2002; Pearce et al. 1983a; Pearce et al. 1983b; Pearce et al. 1984; Pearce et al. 1985; Pearce and Howard 1985; Pearce et al. 1991; Pearce et al. 1993; Sporle et al. 2002; Tobias and Cheung 2001b). However, the trend in socio-economic inequalities in mortality in New Zealand have not been documented, other than one study that suggests some increasing relative inequality by occupational class using unlinked census and mortality data. (Pearce et al. 2002)

In New Zealand there are also profound differences in health status between the major ethnic groupings, and these disparities increased during the 1980s and 1990s. For Maori, the indigenous population of New Zealand, life expectancy in 1996-99 was approximately 10 year lower than their non-Maori non-Pacific compatriots; and among Pacific people, a largely migrant population, life expectancy was approximately 7 years less (Ajwani et al. 2002; Blakely et al. in press).

It is highly plausible that at least some of the widening ethnic inequalities in health during the 1980s and 1990s were due to the reforms more adversely affecting Mäori and Pacific people. For example, the percentage of families with one or more European adults with a net-of-housing-cost income less than 60% of the median income was 12.6% in 1987-88, peaked at 23.3% in 1991-92, and fell to 18.5% in 1997-98. By contrast, the equivalent percentages for families with one or more Mäori adults were 14.0%, 41.0% and 31.2%, and

with one or more Pacific adults were 24.4%, 48.9%and 44.3% (Ministry of Social Development 2004)

Both socio-economic position and ethnicity matter in New Zealand. Not all of the ethnic inequalities are mediated by socio-economic position, and socio-economic mortality gradients exist within each ethnic group (Blakely et al. 2002a; Salmond et al. 1998; Sporle et al. 2002). In epidemiological terms, ethnicity is a confounder of the association between socio-economic position and mortality.

The role of CVD in trends in socio-economic mortality gradients

Internationally, decreasing mortality rates and increasing relative inequality have been particularly marked for cardiovascular disease. So countries for which CVD mortality contributes a large proportion of all deaths might be expected to show greater increases in inequality in all-cause mortality (Mackenbach et al. 2003; Martikainen et al. 2001b). Mackenbach et al. (2003) calculated the proportional contribution of CVD to the increase in relative inequality by education and occupation, and found that increasing inequality for CVD mortality in the Northern European countries accounted for approximately half of the increase in overall inequality. In New Zealand there has also been a substantial decline in CVD mortality. The decline, however, was largely confined to the majority ethnic group and not experienced by the Māori and Pacific populations (Ajwani et al. 2003).

(2) Purpose of this paper

In this paper we compare inequalities in mortality by education between New Zealand, Denmark, Finland and Norway during the 1980s and 1990s, with particular attention to cardiovascular (CVD) mortality. Three particular questions are addressed: first, are mortality inequalities bigger or smaller in New Zealand than in Nordic countries?; second, are trends over time in educational inequalities in total mortality in New Zealand different to those in Nordic countries?; third, are trends in educational inequalities in CVD and non-CVD mortality in New Zealand different to those in Northern Europe?

9.3. Methods

Data Sources: The New Zealand Census-Mortality Study (NZCMS) comprises four cohorts. The cohorts were established using anonymous and probabilistic linkage methods, described elsewhere, to link census to mortality records for three years subsequent to the 1981, 1986, 1991 and 1996 censuses (Blakely and Salmond 2002; Blakely et al. 2002b).

Linked census-mortality data was obtained for Finland, Denmark, and Norway by education level for three periods covering for three time periods – approximately 1981-85, 1986-90 and 1991-95.

Analyses were limited to respondents aged 30-59 years at the beginning of each follow-up period, as data for this age group was available for all four countries. Furthermore a high proportion of New Zealanders aged 60 and over reported no educational qualifications recorded in the early cohorts, allowing for limited discrimination by educational level, especially for females. Because the size of inequalities varies by age, harmonising the age criteria across countries enables us to make observations about both the size of inequalities and trends in inequalities over time.

National educational classifications were reclassified into a three level classification corresponding to comparable stages of the international OECD classification of education (OECD 1990). These were low (pre-primary, primary and lower secondary), medium (upper secondary schooling) and high (post-secondary and tertiary). A further division of the high classification into post-secondary and tertiary (university) qualifications was used for calculation of the relative index of inequality (RII) and slope index of inequality (SII).

Age, and age and ethnicity, standardised mortality rates were calculated by the direct method (using five year age strata) with the European Standard Population as the Standard (Ahmad et al.; Doll and Cook 1967).

The RII and SII are summary measures of inequality that take account of the population distribution by education level. The RII and SII are also relatively insensitive to differences in the educational classification used in each country, so long as a hierarchy of educational levels is maintained (Mackenbach and Kunst 1997). Weighted linear regression of the standardised mortality rates on the midpoint of the cumulative proportion of the population distribution was conducted, where the weights were the total person time in each education

category (Pamuk 1985; Valkonen 1993). The RII and SII were then calculated from the regression output, whereby RII=(α+β)/α and SII =-β (slope). Confidence intervals were calculated using the method published by Hayes (2002).

9.4. Results

Table 9-1 gives the total person-years of follow-up in each cohort, the distribution of the population by education level and the number of deaths from all causes and cardiovascular diseases. The distribution of the population in each education category varied by country, with each country showing a shift over time towards a greater proportion in higher education groups. Changes in population distribution were particularly pronounced for females and more pronounced for New Zealand than for other countries.

The proportion of deaths due to CVD was higher in New Zealand than in all other countries - except for males in the first cohort where the proportion of deaths due to CVD (45%) was similar to that in Finland (47%). In all countries the proportion of deaths due to CVD declined, to a variable extent, over time.

Table 9-2 shows standardised mortality rates by education level for mortality from all causes. Higher education levels were consistently associated with low mortality in all countries in each period. Mortality rates declined in all countries. In all instances, except New Zealand, the rate of morality rate decline was highest in the high education group and least in the low education groups. Indeed, among females, the low education group showed no decline in overall mortality in Denmark, Finland and Norway. In New Zealand there was little difference in the rate of mortality decline by education level among males, while for females mortality declined by 9%, 18% and 15% for low, medium and high education groups respectively.

The proportional decline in CVD mortality was 2-3 times the rate of decline for all cause mortality. The pattern of decline in CVD by education level was very similar to that for all cause mortality in each country.

Table 9-1 Person-Years of Follow-up, deaths, and population distribution by Education Level among 30-59 year olds.

Country	Time Period	Person-Years (1000s)	Distribution of Population by Education Level (%)			Deaths		
			Low	Medium	High	All Causes (n)	CVD (n)	CVD (%)
Females								
New Zealand*	1981-84	1 379	61%	17%	22%	4 422	1 266	29%
	1986-89	1 569	47%	21%	31%	4 344	1 035	24%
	1991-94	1 830	38%	25%	38%	4 599	1 023	22%
Denmark	1981-85	4 049	57%	28%	15%	14 682	2 667	18%
	1986-90	4 250	47%	34%	19%	15 086	2 538	17%
	1991-95	4 549	37%	41%	22%	15 263	2 262	15%
Finland	1981-85	4 642	61%	30%	9%	12 624	3 954	31%
	1986-90	4 898	51%	38%	11%	12 538	3 356	27%
	1991-95	5 117	41%	45%	13%	11 924	2 545	21%
Norway	1981-85	3 419	43%	45%	13%	9 058	2 032	22%
	1986-90	3 485	35%	49%	17%	8 723	1 814	21%
	1991-95	3 735	27%	52%	21%	7 959	1 365	17%
Males								
New Zealand*	1981-84	1 429	53%	15%	32%	7 470	3 333	45%
	1986-89	1 612	38%	16%	46%	7 491	3 102	41%
	1991-94	1 807	33%	18%	49%	7 134	2 643	37%
Denmark	1981-85	4 043	59%	23%	19%	23 021	8 119	35%
	1986-90	4 248	50%	29%	21%	23 155	7 112	31%
	1991-95	4 553	41%	37%	22%	23 145	5 996	26%
Finland	1981-85	4 541	58%	31%	11%	32 681	15 213	47%
	1986-90	4 931	49%	38%	12%	32 899	13 314	40%
	1991-95	5 195	42%	45%	13%	30 035	10 524	35%
Norway	1981-85	3 465	36%	45%	19%	18 794	8 113	43%
	1986-90	3 555	30%	49%	22%	16 967	6 775	40%
	1991-95	3 830	24%	52%	25%	14 750	4 907	33%

*Counts of Deaths Random Rounded to Multiples of Three according to Statistics New Zealand protocol

Table 9-2 All Cause Mortality rates per 100,000 years (95% CI) by Education Level, Period and Sex

Country	Period	Females			Males		
		Low	Medium	High	Low	Medium	High
New Zealand*	1981-84	383	308	262	651	510	434
	1986-89	369	284	239	635	497	424
	1991-94	370	261	225	582	415	372
	Change in rate, 1981 to 1994	-38 (-10%)	-76 (-25%)	-54 (-21%)	-96 (-15%)	-149 (-29%)	-126 (-29%)
New Zealand†	1981-84	384	333	280	644	516	472
	1986-89	361	294	256	611	517	450
	1991-94	350	272	238	542	427	396
	Change in rate, 1981 to 1994	-34 (-9%)	-61 (-18%)	-42 (-15%)	-102 (-16%)	-89 (-17%)	-76 (-16%)
Denmark*	1981-85	423	360	325	677	614	485
	1986-90	437	363	304	679	602	446
	1991-95	421	349	282	655	564	391
	Change in rate, 1981 to 1995	-2 (0%)	-11 (-3%)	-43 (-13%)	-22 (-3%)	-50 (-8%)	-94 (-19%)
Finland*	1981-85	305	239	214	903	660	473
	1986-90	308	239	193	867	632	392
	1991-95	306	211	178	769	565	331
	Change in rate, 1981 to 1995	1 (0%)	-28 (-12%)	-36 (-17%)	-134 (-15%)	-95 (-14%)	-142 (-30%)
Norway*	1981-86	300	236	195	672	521	373
	1986-91	316	247	197	680	490	346
	1991-95	300	216	174	604	420	280
	Change in rate, 1981 to 1995	0 (0%)	-20 (-8%)	-21 (-11%)	-68 (-10%)	-101 (-19%)	-93 (-25%)

*age standardised †age and ethnicity standardised

Are mortality inequalities bigger or smaller in New Zealand than in Nordic countries?

The SII and RII for all-cause mortality are shown in Table 9-3. It is evident from these results that the position of New Zealand relative to the Nordic countries depends on whether one considers males or females, absolute (SII) or relative (RII) measures of inequality, and age- or age and ethnicity standardised mortality rates for New Zealand. Comparing New Zealand ethnicity standardised results to other countries at any point in time, the female all cause RII were similar to those for the Nordic countries, but among males were less than the RII for Norway and Finland, and similar to Denmark. Considering absolute inequality; for females the SII were again of a similar order to the Nordic countries. However for males the SII was similar to Denmark but less than Finland or Norway.

The position of New Zealand changes when only age-standardised results are considered, especially for females for whom the age-standardised RII and SII are higher than for all other countries. For males, however the age-standardised measures are greater than for Denmark but still less than both Finland and Norway.

Are trends over time in educational inequalities in mortality in New Zealand different to those in Nordic countries?

Figure 9-1 shows the RII for all causes, CVD and other causes combined, by country and period (confidence intervals for the RII are given in Table 9-3 and Table 9-4). For females the increase in all-cause inequality is least in New Zealand (42%), when based on ethnicity standardised data, and most in Finland (65%); for males the increase is the least in New Zealand and Finland (31%), compared to Norway (66%) and Denmark (71%). For females the SII in increased over time in all countries, except possibly New Zealand. In contrast, for males, absolute inequalities were fairly stable in all countries except Denmark where the SII increased by 33% between 1981-85 and 1991-95.

Are trends in educational inequalities in CVD and non-CVD mortality in New Zealand different to those in Northern Europe?

The RII for CVD increased in all countries (Figure 9-1 and Table 9-4). Among females the increase in the RII for CVD was substantially greater in New Zealand than in the Nordic countries, whether based on age-standardised or age and ethnicity standardised results. For males, the increase was greatest in Norway intermediate in New Zealand and least in

Denmark and Finland. Conversely the RII for other causes was stable in New Zealand but increased in all other countries. However in the later (1996-99) New Zealand cohort, where no European data were available, the RII for other causes does however increase.

The absolute measure of inequality, the SII was stable or decreased in all countries for CVD, but for other causes increased in all countries except New Zealand. The rapid declines in overall CVD mortality meant that the importance of CVD to absolute inequality has declined in all countries (not shown).

Table 9-3 Relative (RII) and Absolute Inequality (SII) by Country and Period.

Country	Period	RII (95% CI)		SII (95% CI)	
		Females	Males	Females	Males
New Zealand*	1981-84	1.85 (1.58- 2.17)	2.03 (1.80- 2.28)	205 (184- 226)	380 (357- 404)
	1986-89	2.11 (1.81- 2.46)	2.11 (1.88- 2.38)	221 (187- 256)	368 (280- 456)
	1991-94	2.30 (1.97- 2.68)	2.33 (2.06- 2.64)	227 (136- 319)	357 (204- 510)
	Change‡	0.45 (53%)	0.30 (29%)	22 (11%)	-23 (-6%)
New Zealand†	1981-84	1.62 (1.28- 2.04)	1.68 (1.39- 2.04)	166 (131- 201)	291 (217- 365)
	1986-89	1.83 (1.58- 2.13)	1.81 (1.61- 2.04)	184 (127- 242)	299 (187- 411)
	1991-94	1.88 (1.60- 2.21)	1.89 (1.67- 2.13)	176 (118- 235)	273 (132- 415)
	Change‡	0.26 (42%)	0.21 (31%)	10 (6%)	-18 (-6%)
Denmark*	1981-85	1.49 (1.39- 1.60)	1.55 (1.47- 1.64)	153 (127- 178)	271 (120- 424)
	1986-90	1.69 (1.57- 1.81)	1.73 (1.63- 1.83)	198 (169- 227)	324 (166- 481)
	1991-95	1.73 (1.61- 1.86)	1.94 (1.83- 2.06)	194 (175- 213)	361 (189- 533)
	Change‡	0.24 (49%)	0.39 (71%)	41 (27%)	90 (33%)
Finland*	1981-85	1.69 (1.55- 1.84)	2.24 (2.12- 2.36)	142 (128- 155)	598 (497- 700)
	1986-90	1.83 (1.68- 1.99)	2.51 (2.37- 2.65)	158 (127- 189)	618 (478- 758)
	1991-95	2.14 (1.97- 2.33)	2.63 (2.48- 2.78)	179 (101- 257)	558 (414- 701)
	Change‡	0.45 (65%)	0.39 (31%)	37 (26%)	-40 (-7%)
Norway*	1981-85	1.79 (1.66- 1.94)	2.18 (1.95- 2.43)	147 (118- 175)	406 (352- 460)
	1986-90	1.89 (1.69- 2.11)	2.57 (2.41- 2.74)	162 (157- 167)	452 (364- 541)
	1991-95	2.16 (1.94- 2.41)	2.96 (2.72- 3.22)	169 (114- 224)	424 (324- 524)
	Change‡	0.37 (47%)	0.78 (66%)	22 (15%)	18 (4%)

*age standardised †age and ethnicity standardised

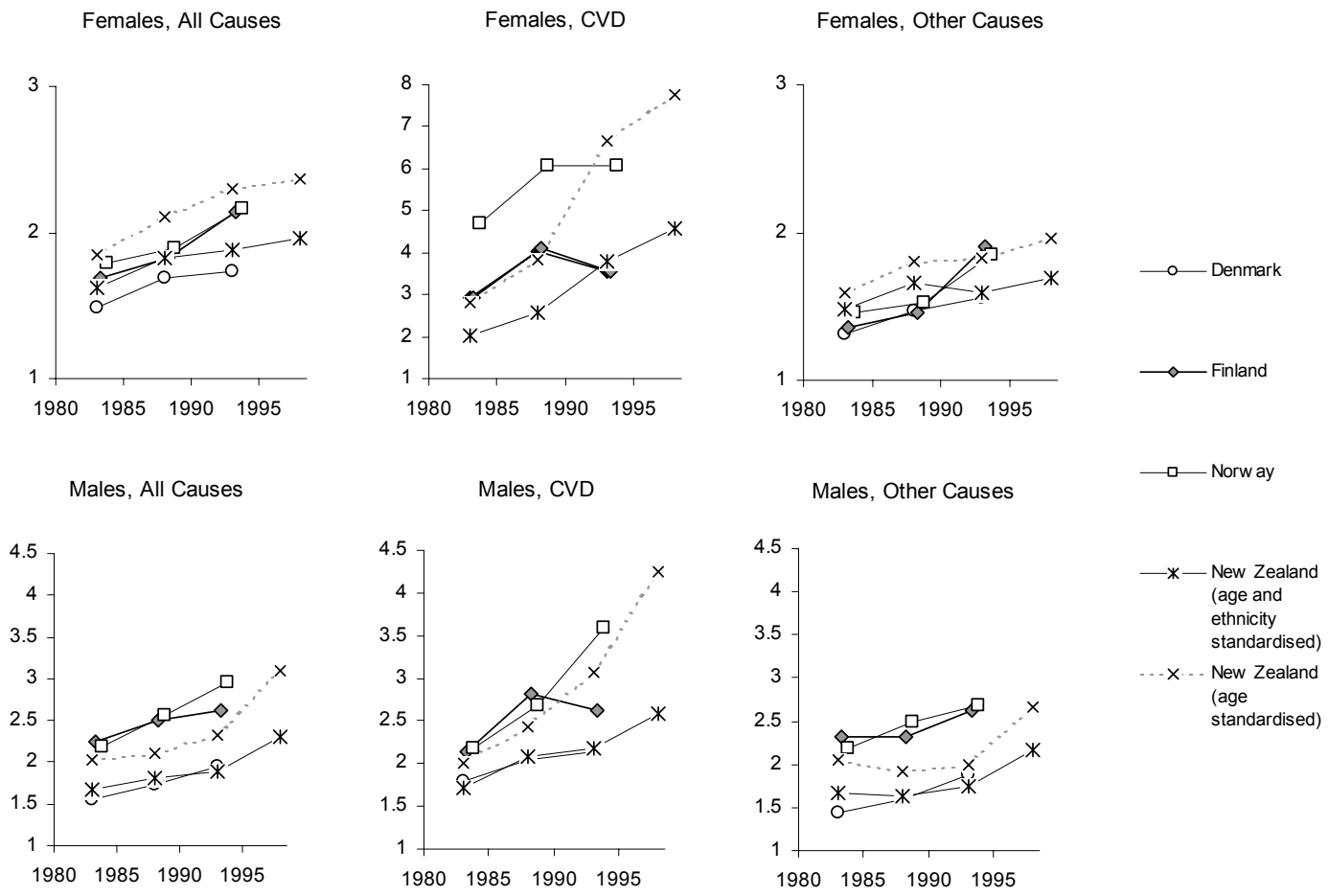
Table 9-4 Relative Inequality (RII 95%CIs) for CVD and Other Causes by country, sex and period.

Country	Period	Females						Males					
		CVD			Other Causes			CVD			Other Causes		
New Zealand*	1981-84	2.80	(2.00-	3.92)	1.59	(1.33-	1.91)	2.00	(1.68-	2.39)	2.05	(1.75-	2.41)
	1986-89	3.84	(2.57-	5.74)	1.80	(1.52-	2.12)	2.44	(2.02-	2.95)	1.91	(1.64-	2.21)
	1991-94	6.68	(3.67-	12.16)	1.83	(1.56-	2.16)	3.06	(2.45-	3.82)	2.00	(1.72-	2.33)
	Change‡	3.88	(216%)		0.24	(41%)		1.06	(106%)		-0.05	(-5%)	
New Zealand†	1981-84	2.01	(1.37-	2.94)	1.48	(1.11-	1.97)	1.71	(1.39-	2.11)	1.66	(1.23-	2.24)
	1986-89	2.56	(1.82-	3.60)	1.66	(1.41-	1.96)	2.09	(1.73-	2.51)	1.64	(1.41-	1.91)
	1991-94	3.81	(2.49-	5.83)	1.59	(1.33-	1.89)	2.17	(1.75-	2.67)	1.74	(1.50-	2.02)
	Change‡	1.80	(178%)		0.11	(23%)		0.46	(65%)		0.08	(12%)	
Denmark*	1981-85	2.92	(2.38-	3.57)	1.31	(1.21-	1.41)	1.79	(1.62-	1.97)	1.44	(1.34-	1.54)
	1986-90	4.03	(3.14-	5.16)	1.47	(1.36-	1.58)	2.04	(1.83-	2.27)	1.60	(1.50-	1.71)
	1991-95	3.56	(2.76-	4.60)	1.56	(1.45-	1.68)	2.14	(1.90-	2.42)	1.88	(1.76-	2.01)
	Change‡	0.64	(33%)		0.25	(81%)		0.35	(44%)		0.44	(100%)	
Finland*	1981-85	2.93	(2.45-	3.51)	1.36	(1.24-	1.51)	2.15	(1.99-	2.33)	2.32	(2.16-	2.50)
	1986-90	4.10	(3.25-	5.16)	1.46	(1.33-	1.60)	2.81	(2.56-	3.08)	2.32	(2.17-	2.48)
	1991-95	3.55	(2.79-	4.51)	1.91	(1.74-	2.09)	2.62	(2.38-	2.89)	2.63	(2.46-	2.82)
	Change‡	0.62	(32%)		0.55	(153%)		0.47	(41%)		0.31	(23%)	
Norway*	1981-85	4.70	(3.59-	6.15)	1.46	(1.34-	1.59)	2.17	(1.73-	2.73)	2.18	(2.00-	2.39)
	1986-90	6.06	(4.34-	8.46)	1.52	(1.35-	1.72)	2.68	(2.41-	2.97)	2.50	(2.30-	2.71)
	1991-95	6.07	(3.77-	9.77)	1.85	(1.65-	2.06)	3.60	(3.10-	4.19)	2.69	(2.43-	2.99)
	Change‡	1.37	(37%)		0.39	(85%)		1.43	(122%)		0.51	(43%)	

*age standardised †age and ethnicity standardised

‡ Change between first and last cohort in both absolute and percentage terms. The change in percentage terms for the RII is that for the 'excess RII', i.e. compared to RII .

Figure 9-1 RII by Education Level, by Time Period, Country and Cause of Death – ages 30-59 years



9.5. Discussion

Mortality was associated with education in New Zealand as in Europe. The strength of these inequalities, and trends in these inequalities, were broadly similar for all-cause mortality. Our study has an advantage over earlier comparisons as analyses were restricted to respondents aged 30-59 years. It is preferable to compare inequalities across similar age ranges because both the magnitudes of inequalities in mortality by education and trends in these inequalities are modified by age (Avendano et al. 2004; Blakely et al. 2002b; Kunst and Mackenbach 1994b; Mackenbach et al. 2004).

More detailed interpretation of our findings, however, requires positioning the results in terms of ethnic inequalities in health in New Zealand, and the role of CVD and non-CVD disease mortality.

(1) Ethnicity matters

It is not routine to consider, or adjust for, ethnic inequalities in health in European studies of socio-economic inequalities. In New Zealand, however, ethnicity is a major axis of health inequality alongside socio-economic position. Whether it is most appropriate to base the New Zealand comparisons on ethnicity standardised results or age only standardised results is a moot point.

There is ample evidence that ethnicity, being both a determinant of socioeconomic position and independently associated with mortality, confounds the association of education and mortality (Ajwani et al. 2003; Blakely et al. in press). However ethnicity is also strongly associated with factors that are likely mediators of the relationship between education and mortality - including income, deprivation, smoking behaviour, and work related exposures. In this case ethnicity becomes a proxy, albeit imperfect, measure of intermediary variables in the association of education and mortality. Thus, standardisation for ethnicity is likely to do more than just adjust for confounding; it may also by proxy over-adjust for intermediary mechanisms. The true measure of educational inequality is likely to lie somewhere between the age- and age and ethnicity standardised results.

Furthermore given the economic stratification of society, whereby some occupations are low paid, and state income support is structured to provide a low-level of income relative to the employed population, all western societies have sub-populations that are over

represented in low status positions. Adjusting for ethnicity may, therefore, also inappropriately obscure the total health inequality in the population.

Returning to our first research question, "are mortality inequalities bigger or smaller in New Zealand than in Nordic countries at any one point in time?" If the 'best' measure of New Zealand's educational inequality in mortality for cross-national comparisons lies somewhere between the age- and age and ethnicity standardised results, then inequalities in New Zealand are at the high end compared to Nordic countries for females (i.e. as high as Denmark), and they are low to average compared to Nordic countries for males.

Regarding our second research question "are trends over time in educational inequalities in total mortality in New Zealand different to those in Nordic countries", without ethnicity standardisation there was a greater rate of increase in relative inequality over time. On balance though, whether or not ethnicity was adjusted for the rate of increase in relative inequalities in all-cause mortality was broadly similar across countries.

Perhaps most importantly, the reason that New Zealand did not experience a greater increase in mortality inequality by education may thus be because the increase in structural inequalities over the 1980s occurred primarily around a different axis social inequality, that of ethnicity.

(2) The role of trends in CVD and other causes of death

In relative terms, male inequalities in CVD increased most in Norway and New Zealand up to the mid-1990s and female inequalities clearly increased most in New Zealand (Figure 9-1). Further, even more pronounced increases in relative inequalities occurred for both males and females in New Zealand in the late 1990s – but there is no comparison data for the Nordic countries.

In contrast for other causes of death relative inequalities increased the least in New Zealand (Figure 9-1). The net result in terms of all-cause mortality was that the rate of increase in relative inequalities was similar across countries – albeit driven more by CVD in New Zealand and more by non-CVD in Nordic countries.

(3) Do our findings support the hypothesis that rapid and radical structural change was associated with more rapid increases in health inequalities?

Only partially, in that relative inequalities in CVD (but not non-CVD nor all-causes combined) increased more rapidly in New Zealand. Cancer deaths are a major fraction of non-CVD deaths. As the etiological processes that cause cancer take decades, it is unlikely that structural and socio-economic change will manifest quickly in changing socio-economic gradients in cancer mortality – although access to health services and therefore inequalities in survival may be important at the margin. (A cross-national comparison of cancer, suicide, and unintentional injury inequalities was beyond the scope of this paper.) Returning to CVD, as death from CVD is readily prevented by treatment, and the risk of CVD due to risk factors such as smoking responds reasonably quickly to changing behaviour (Capewell et al. 2000) it is not unreasonable to hypothesise that some of the rapid rise in CVD inequalities in New Zealand may have been due to rapidly increasing socio-economic inequalities during the 1980s and 1990s.

SUMMARY

Inequalities in all-cause mortality were of a broadly similar strength in New Zealand and Nordic countries. And trends in inequality over time were broadly consistent for all-causes combined. However, there was variation by cause of death in that relative inequalities in CVD increased most in New Zealand, and inequalities in non-CVD increased most in Nordic countries. Overall, inequalities in mortality in New Zealand do not seem to have widened more rapidly than in northern European countries. However, rapid social and economic change may have affected trends in CVD mortality among low educated men and women, and especially the ethnic minority groups.

Chapter 10 Discussion

10.1. Summary of Results

The first aim of this thesis was to compare the strength of the relationship of socioeconomic factors with mortality *across time* in New Zealand, with a specific focus on cardiovascular disease mortality. I have found that mortality rates decreased proportionately more in high socioeconomic groups than in low socioeconomic groups over the period from 1981-84 to 1996-99. Consequently the position of low socioeconomic groups in relation to high socioeconomic groups has worsened, together with the overall index of relative inequality across the entire population.

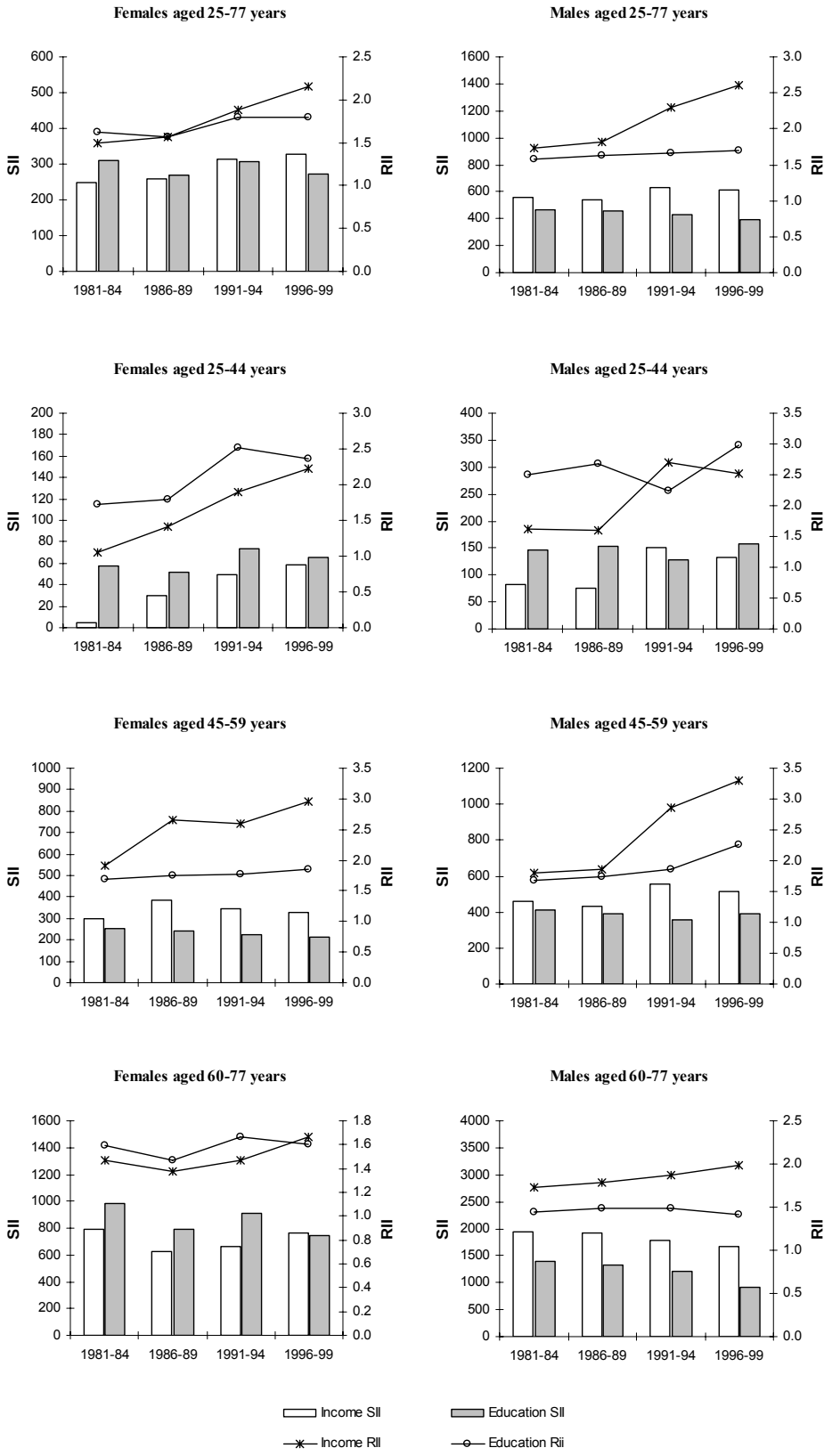
Cardiovascular disease mortality was strongly associated with socioeconomic position in all four cohorts and the strength of the association increased over time. However a halving of the CVD mortality rate across the entire population aged 25 to 77 years means that the absolute gap in mortality between high and low socioeconomic groups declined for females and was mostly stable for males. Greater declines in mortality for cardiovascular disease compared with other causes of death mean that the contribution of cardiovascular disease to overall inequalities is declining over time and other diseases are becoming more important contributors to all cause inequality.

These broad general conclusions pointing towards increasing relative but stable absolute inequality measures however obscure important differences in trends that observed by age, sex, ethnicity and cause of death. Figure 10-1 and Figure 10-2 summarise the trends in relative and absolute inequality by socioeconomic measure, sex and age. A discussion of how to interpret these variations is the focus of much of the following discussion.

The second aim of this thesis was to compare trends in the strength and nature of the relationship of socioeconomic factors with mortality in New Zealand with those demonstrated internationally. Using linked census mortality data from Denmark, Norway and Finland trends in inequality by education were assessed on the basis of the RII and SII for all cause mortality and CVD mortality, among 30-59 year olds for the period from 1981 to 1995. Both the size of inequality measures and trends in inequality in New Zealand were broadly similar to those in Northern Europe although the increase in relative inequality in New Zealand occurred later than in the European cohorts. Whereas both CVD and other

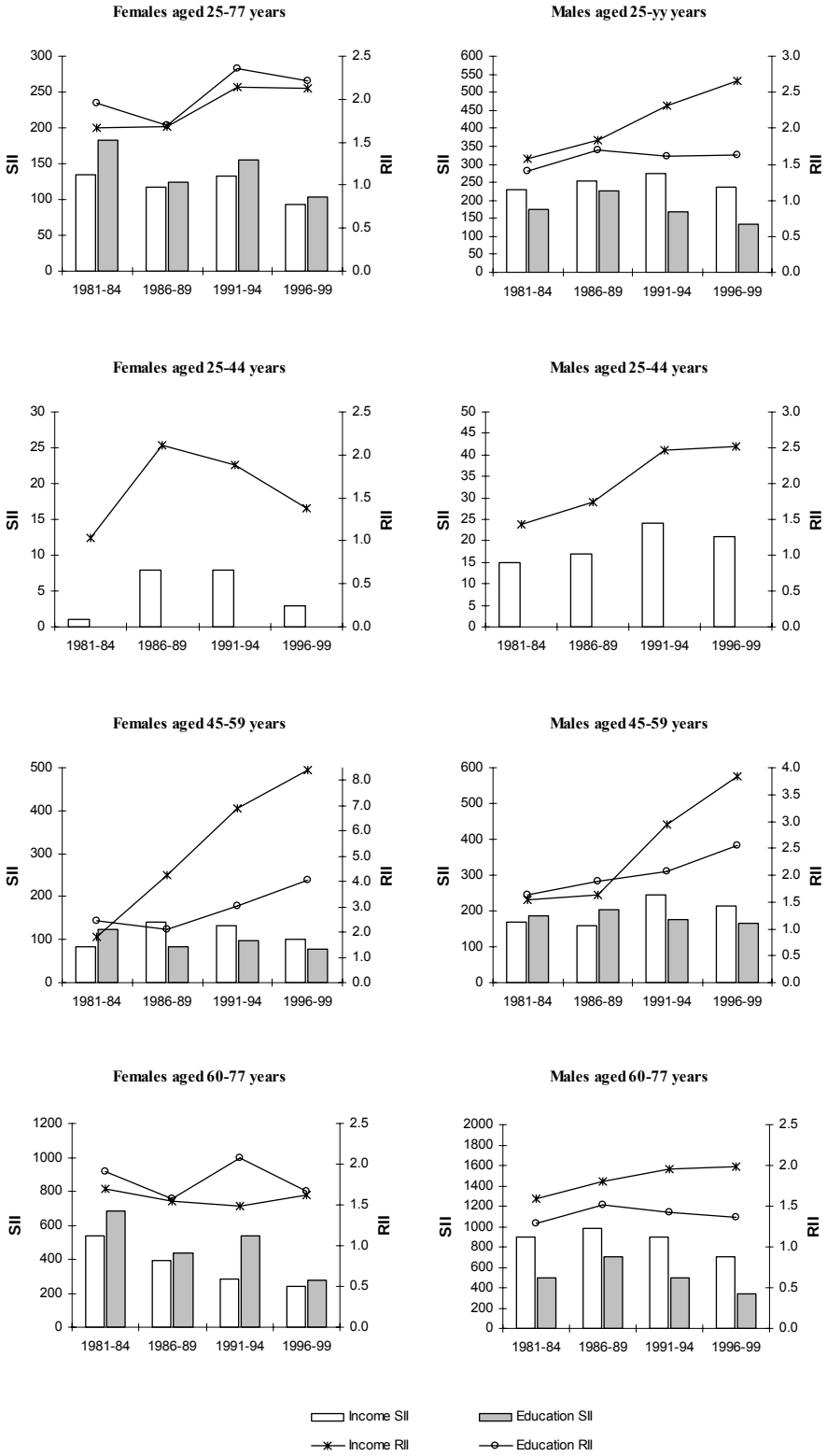
causes contribute to increasing relative inequalities in Europe, in New Zealand the increase in relative inequality between the early 1980s and the early 1990s was primarily the result of increases in relative inequality for CVD.

Figure 10-1 Comparison of Trends in the RII by Socioeconomic Measure, All Cause Mortality, Ages 25-77 years*



*age and ethnicity standardised

Figure 10-2 Comparison of Trends in the RII* by Socioeconomic Measure† CVD Mortality.



*age and ethnicity standardised. †data too sparse to present by education for ages 25-44 years

10.2. Limitations and Strengths of the NZCMS for Comparative Studies

10.2.1 Strengths

The NZCMS study has a number of strengths in the context of comparative studies. First the study covers the entire New Zealand population over a period of major restructuring of economic and social institutions. The inclusion of the full population maximises the power of the study and generalisability of the analyses. Nevertheless death is a relatively rare outcome, especially at young ages, and so analyses of some subpopulations still encounter problems of insufficient statistical power.

The second major advantage of the NZCMS is that the New Zealand census data included multiple measures of socioeconomic position, enabling more robust conclusions through comparisons of trends according to different socioeconomic measures.

A further important factor is that the study design is the same for all four cohorts. The follow-up period is three years in each cohort, and so the interpretation of trends is unaffected by variation in the period between measurement of exposure and outcome assessment

10.2.2 Limitations

Limitations inherent within the NZCMS cohorts affect all analyses based on these data, including this thesis. Particular limitations of relevance to comparative studies are: (1) incomplete linkage of mortality records back to the census cohort; (2) the short period of follow-up; (3) a lack of means to follow-up cohort members not linked to a mortality record; (4) changes in the census survey instrument; and (5) incomplete exposure data for most socioeconomic measures.

The proportion of mortality records linked back to mortality records was about 75% in each cohort. Incomplete linkage introduces two problems. Firstly mortality rates will be underestimated to the degree that mortality records are unlinked. Secondly if linkage is biased by the social and economic variables of interest in the analyses then measures of association between socioeconomic position and mortality will also be biased. Non-linkage effectively produces a misclassification of the outcome variable, whereby a cohort member

who in fact died during the follow-up period is recorded as living throughout the cohort period.

Analyses of the mortality data showed that linkage rates varied by a number of factors, including age, sex, ethnicity, deprivation index of the area of residence, rurality of place of residence, cause of death and time since census. Of these factors, all except rurality were known from other studies to be predictors of mortality outcome. In order to adjust for non-linkage, cohort records were weighted within demographic strata. These strata were based on age, sex, cause of death, ethnicity (prioritised ethnic group), rurality of residence and deprivation index of area of residence. The weights were most effective at adjusting for linkage bias, for strata with relatively high mortality rates. In this case weights can be calculated for detailed strata. However where mortality is a rarer outcome strata were merged to ensure sufficient deaths in each strata. In these cases the weights did not always exactly adjust for the non-linkage. Hence the weighting is less effective for younger cohort members and for rare outcomes.

The NZCMS cohorts link death for just three years subsequent to each census. The high mobility of the New Zealand population means that the linkage, which matched census and mortality records within areas of residence, based on small geographical areas (meshblocks), becomes increasingly problematic with increasing time lapsed after each census (Fawcett et al. 2002). The relatively short period of follow-up limits the usefulness of the data for analyses of rarer outcomes, including stroke, and for younger cohort members for whom death is a rare outcome. Hence, despite the size of the cohorts, statistical power is limited for some analyses. However given that the studies include the whole New Zealand population sampling variability is of less relevance to the interpretation of results than the effect of systematic biases introduced though the census survey instruments and by non-linkage. As discussed above the latter was largely adjusted for through weighting of the cohorts.

The NZCMS has no means of following cohort members who were not linked to a mortality record. Thus it must be assumed that all cohort members remain at risk of mortality until the end of the follow-up period. This will in fact not be the case as all cohortees who emigrate are no longer at risk of dying in New Zealand. In theory this means that the denominator for all mortality rate calculations will be slightly inflated with increased time lapsed since follow-up. However the effect is likely to be small.

Noise introduced into the study as a consequence of random variations, is inevitably a problem in comparative studies with multiple axes of comparison – time period, age, sex, ethnicity and socioeconomic position. Valid conclusions require variations to broader trends consider the effect of random noise as an explanation for observed variations from the broader trends.

Bias is introduced into the results through the census survey instrument by misclassification of exposures and by missing data for variables and covariates of interest. Comparisons over time and between studies are further complicated by the potential for the effect of bias to be different in each cohort. Misclassification of the exposure was most evident for the educational trend analyses.

It was possible to detect a differential misclassification of educational qualifications in the 1981-84 cohort. In an older adult population we would expect that the highest educational qualification level would be unchanged for most people. In fact the proportion of each cohort with no qualifications decreased sharply over the first inter-censal period. For example 70% of cohort members aged 50-54 years in 1981 had no qualifications but five years later only 59% were recorded as having no qualifications. It was perhaps fortunate that another measure of educational level was collected in the 1981 census – highest level of educational attendance. Reassignment of educational qualifications for those with no qualifications had a minimal effect on inequality measures. The SRR and RII decreased marginally for women and remained virtually unchanged for men. Similarly the SRD and SII declined slightly for women but were largely unchanged for men. The relative stability of the inequality measures, especially the RII and SII, gives some confidence to the interpretation of trends in inequality.

The household income variable could be misclassified in a number of ways. Annual income in the year of the census may not reflect typical yearly income levels. This is particularly the case where income is disrupted for part of the year, whether due to illness, unemployment or other factors. Downward drift in the income of sick cohort members would bias upwards the association of low income with high mortality rates. Second, the household composition at the time of the census may not reflect the usual composition in the year in which income is

being assessed[6]. Third, the equivalisation factors used to adjust for economies of scale were the same for each census. Equivalence scales are however, known to be affected by differences in the changes in the relative prices of the goods and services used in the construction of the scales. (Easton and Ballentyne 2002) It is likely that households with different compositions are affected differently by differential movements in the prices of goods and services. There is also evidence that the economies of scale are different for poorer households than for richer households. Whether the imprecision in the equivalence adjustment causes bias due to differential misclassification in the NZCMS cohorts is unclear, but it is likely that the adjustment in poor households with children may produce an over-estimate of household equivalised income.

When developing the 1991 and 1996 versions of the New Zealand Socioeconomic Index Davis et al (1999) estimated that the incomes of the self-employed were under-reported, on the census, by around one-third. There has also been an increase in the proportion of the population who are self-employed (Department of Social Welfare 1999) On the NZCMS cohorts the proportion of respondents who were self-employed increased from 13% in 1981 to 15% in 1996. Self-employment was also more common at the extremes of the income distribution.

Selection bias was an issue to some degree for all three socioeconomic analyses. Selection bias occurs when selection into the cohort is conditioned by a factor that is associated with both the exposures of interest and mortality. The potential effect of the selection bias depends to what extent potential cohortees are excluded from the analysis, and the degree of bias operating in the selection. To be excluded from any of the analyses required missing exposure data. Where mortality rates among the excluded cohort, within strata of socioeconomic factor, are different to those for the selected cohort, if there is no bias in the relative inequality measure, then there must be bias in the absolute inequality measures and vice versa. Hence where the mortality rates for the excluded cohort are different to those for the included cohort this points to likely bias in either the relative or absolute measures of inequality. Table 10-1 summarises the likely impact of selection bias by socioeconomic variable as discussed in sections 5.3.2.1, 6.3.2.1 and 7.3.2.

---

[6] Households with normally resident adults (18 years) who were absent on census night were excluded from these analyses.

Changes in the census questions over time introduce variability into the definitions of social and demographic variables over time. Of particular relevance for this thesis were substantial changes in the definition of ethnicity, and changes in the educational qualifications and income questions between 1981 and 1986. However smaller changes occurred between all censuses. The occupational data was the least affected by changing definitions but at the same time was most affected by missing information. The changing definitions of the socioeconomic exposures mean that caveats must be placed about the interpretation of trends in inequality based on rate ratios and rate differences, especially when considering changes between the first two cohorts (1981-84 and 1986-89). In these cases the RII provides a more robust measure of changes in relative inequality.

Table 10-1 Influences on, evidence for, and the likely effect of Selection Bias on measures of inequality for all cause mortality

Factor affecting extent of Selection Bias	SEP measure	Estimate of Effect			
		1981-84	1986-89	1991-94	1996-99
Proportion of cohort excluded due to missing data (Females—Males)	Education	11%-9%	9%--6%	3%--2%	5%--5%
	Income	19%--21%	15%--13%	15%--12%	18%--18%
	Occupation	46%--9%	39%--9%	40%--20%	36%—22%
Excess mortality among excluded cohortees (Females—Males)	Education	3%--14%	5%--21%	1%-- 16% less	41% less—63% less
	Income	26%--15%	49%--24%	41%--17%	19%--1%
	Occupation	83%--128%	93%--165%	103%--126%	101%--104%
Likely effect of selection bias on Relative effect measures	Education	Overestimate	?	?	Almost None
	Income	Overestimate	Overestimate	Underestimate	Underestimate
	Occupation*	?	Underestimate	Underestimate	Underestimate
Likely effect of selection bias on absolute effect measures	Education	None or small underestimate	None or small underestimate	Almost None	Almost None
	Income	Overestimate	Overestimate	Almost None	Almost None
	Occupation*	Underestimate	Underestimate	Underestimate	Underestimate

*the effect of selection bias was much more substantial for females than for males, as a consequence of a higher proportion of females with no current occupational class recorded on the census.

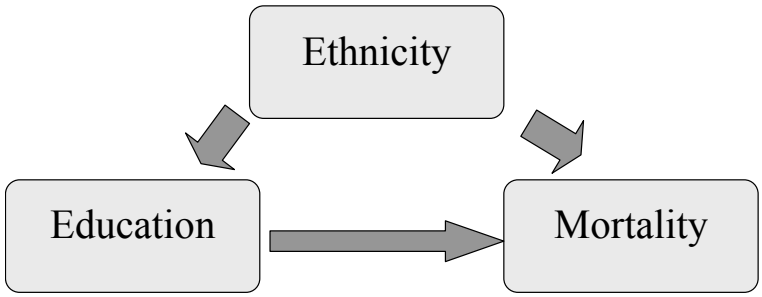
10.3. Ethnicity and socioeconomic status – independent predictors or common indicators?

Standardisation by ethnicity produced substantial reductions in both relative and absolute inequality measures at all points in time. This points to the importance of ethnicity as a confounder of the relationship between socioeconomic position and mortality outcomes. Yet the results presented here almost certainly overstate the degree of confounding by ethnicity and understate the full impact of the socioeconomic measures. Two issues are worth noting:

First I chose to use only analyses of socioeconomic measures with mortality adjusted for age and ethnicty for the assessment of trends. Changing non-random correlated misclassification of variables makes the interpretation of trends based on multivariate measures of socioeconomic position problematic. However the simple stratified analyses do not capture the full range of socioeconomic variation. Within any socioeconomic classification are more graded classifications of socioeconomic position, which are always in the NZCMS correlated with ethnicity. Standardisation by ethnicity addresses the differential in ethnic distribution between income strata but not within strata. Some of the effect of ethnicity is thus in fact an effect of socioeconomic position.

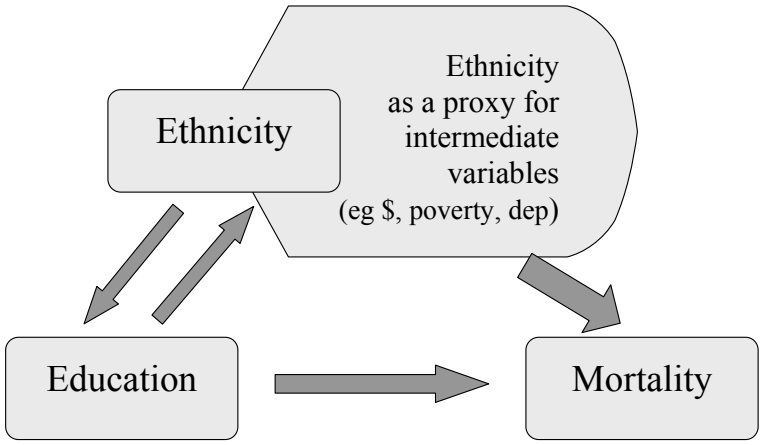
Furthermore the strong association of ethnicity with potential intermediaries of the association between socioeconomic status and mortality means that ethnicity acts as a 'proxy' measure of intermediary factors. This is best illustrated using directional acyclic graphs considering two alternative models.

(a) Ethnicity confounds the association of education and mortality.



In this case it is 'correct' to standardise for ethnicity

(b) Ethnicity is both a confounder and mediator of the association of education and mortality. Ethnicity does not itself mediate the relationship but is strongly associated with mediators of the relationship (e.g. smoking, poverty etc) and so becomes an imperfect proxy for these factors.



In this case standardisation for ethnicity will over-adjust for confounding by ethnicity.

In this thesis the appropriateness or otherwise of standardisation by ethnicity was a particular issue with regard to comparisons of inequalities in New Zealand with Nordic countries. Should *age-* or *age and ethnicity* standardised results form the basis of comparisons with the Nordic countries? There is likely to be no correct answer to this dilemma rather my response has been to present both, with an understanding that the level of inequality associated with education in New Zealand lies somewhere between the two.

A full understanding of the interaction between socioeconomic position and ethnicity requires a different analytic approach than used in this thesis and is the focus of ongoing work on the NZCMS study.

10.4. Questions *Raised and Answered by the Study*

10.4.1 Has the socio-economic patterning of mortality changed between 1981-84 and 1996-99?

In short, "yes", mortality has become more concentrated in lower socioeconomic groups between 1981-84 and 1996-99.

The results of this thesis clearly demonstrate differences in mortality trends for different socioeconomic groups, over the 1980s and 1990s. Overall mortality declined by 32% for females and by 27% for males aged 25-77 years but the decline was not uniform across all subpopulations or socioeconomic groups. In general low socioeconomic groups have experienced smaller proportional declines than high socioeconomic groups, but when mortality decline is considered in absolute terms declines were more alike across strata of socioeconomic position.

Using the formula[7] $PAR\%_{RII} = 100\ (RII - 1)/(RII + 1)$ it is possible to calculate a form of population attributable fraction which measures the percentage of all death across the population attributable to the socioeconomic measure. The $PAR\%_{RII}$ can be interpreted as the proportion of all deaths arising from socioeconomic inequality. Because the RII measures inequality between the 0th and 100th percentile of the socioeconomic position, PAR% estimates based on the RII will necessarily be greater than those based on categorisation.

Table 10-2 shows the extent to which this proportion has increased by age and sex. Divergent socioeconomic mortality trends were particularly pronounced at younger ages, where mortality rates showed little if any improvement among low socioeconomic groups. The most dramatic shift in the burden of inequality occurred for females aged 25-44 years for whom the emergence of strong socioeconomic gradients, where none previously existed, resulted in an increase in the proportion of deaths associated with income inequality from 2% to 38%. Increasing relative inequality, especially by income, has thus resulted in major

[7]See appendix section 12.6 for explanation and method of calculation

shifts in the burden of mortality towards disadvantaged groups, but the trend is more evident in some sub-populations than others.

Table 10-2 PAR%$_{RII*}$ according to income and education, by age and sex

Age	Period	Females		Males	
		Income	Education	Income	Education
All Causes					
22-77 yrs	1981-84	20%	24%	27%	22%
	1986-89	22%	22%	29%	24%
	1991-94	31%	28%	39%	25%
	1996-99	37%	28%	45%	26%
25-44 yrs	1981-84	2%	27%	24%	43%
	1986-89	17%	28%	23%	46%
	1991-94	31%	43%	46%	38%
	1996-99	38%	41%	43%	50%
45-59 yrs	1981-84	32%	26%	29%	26%
	1986-89	45%	27%	30%	27%
	1991-94	44%	28%	48%	30%
	1996-99	49%	30%	53%	39%
60-77 yrs	1981-84	19%	23%	27%	18%
	1986-89	16%	19%	28%	19%
	1991-94	19%	25%	30%	20%
	1996-99	25%	23%	33%	17%
CVD					
22-77 yrs†	1981-84	25%	32%	22%	17%
	1986-89	25%	26%	30%	26%
	1991-94	36%	40%	40%	23%
	1996-99	36%	38%	45%	24%
25-44 yrs	1981-84	1%	..	18%	..
	1986-89	36%	..	27%	..
	1991-94	31%	..	42%	..
	1996-99	16%	..	43%	..
45-59 yrs	1981-84	28%	42%	22%	24%
	1986-89	62%	36%	24%	31%
	1991-94	75%	50%	49%	35%
	1996-99	79%	60%	59%	44%
60-77 yrs	1981-84	26%	31%	23%	13%
	1986-89	22%	22%	29%	21%
	1991-94	20%	35%	32%	18%
	1996-99	24%	25%	33%	16%

*age and ethnicity standardised

10.4.2 Can we draw a general conclusion about trends in socioeconomic inequalities?

Throughout this thesis inequality has been measured both in relative and absolute terms, with many instances of opposite trends in inequality for relative and absolute measures of inequality. What emphasis should be placed on absolute compared with relative inequality? To answer this question requires consideration of the underlying trends in population mortality as well as the trends in mortality within socioeconomic groups. Figure 2-1 outlines a proposed typology of trends in socioeconomic inequalities in mortality. There can be little disagreement about the interpretation of trends in inequality when both relative and absolute inequalities are tracking in the same direction (Types 1 and 5) however where inequalities track in different directions the importance of relative and absolute inequalities is open to debate.

The typology presented here gives equal weight to absolute and relative inequalities. Yet whether this is appropriate depends on the context and application of the data. For policy purposes for example it could be argued that absolute measures of inequality are most appropriate because they reflect the lived experience of the population and the size of the inequality problem. Hence a 50% excess mortality in low compared to high income groups demands a different response when that 50% equates to a mortality rate difference of say 100 compared to 10 per year. Conversely small relative differences may represent a greater number of excess deaths where the cause of death is common.

Equally where the issue of concern is primarily one of equality for disadvantaged groups then trends in relative measures of inequality could be considered more important. Thus if, for example, the primary concern is the lack of improvement over time in the health and mortality of low educated young males then comparing their experience relative to other young males is most appropriate. In this case the unfairness or unjustness of health inequalities is illustrated by the trends in relative inequality.

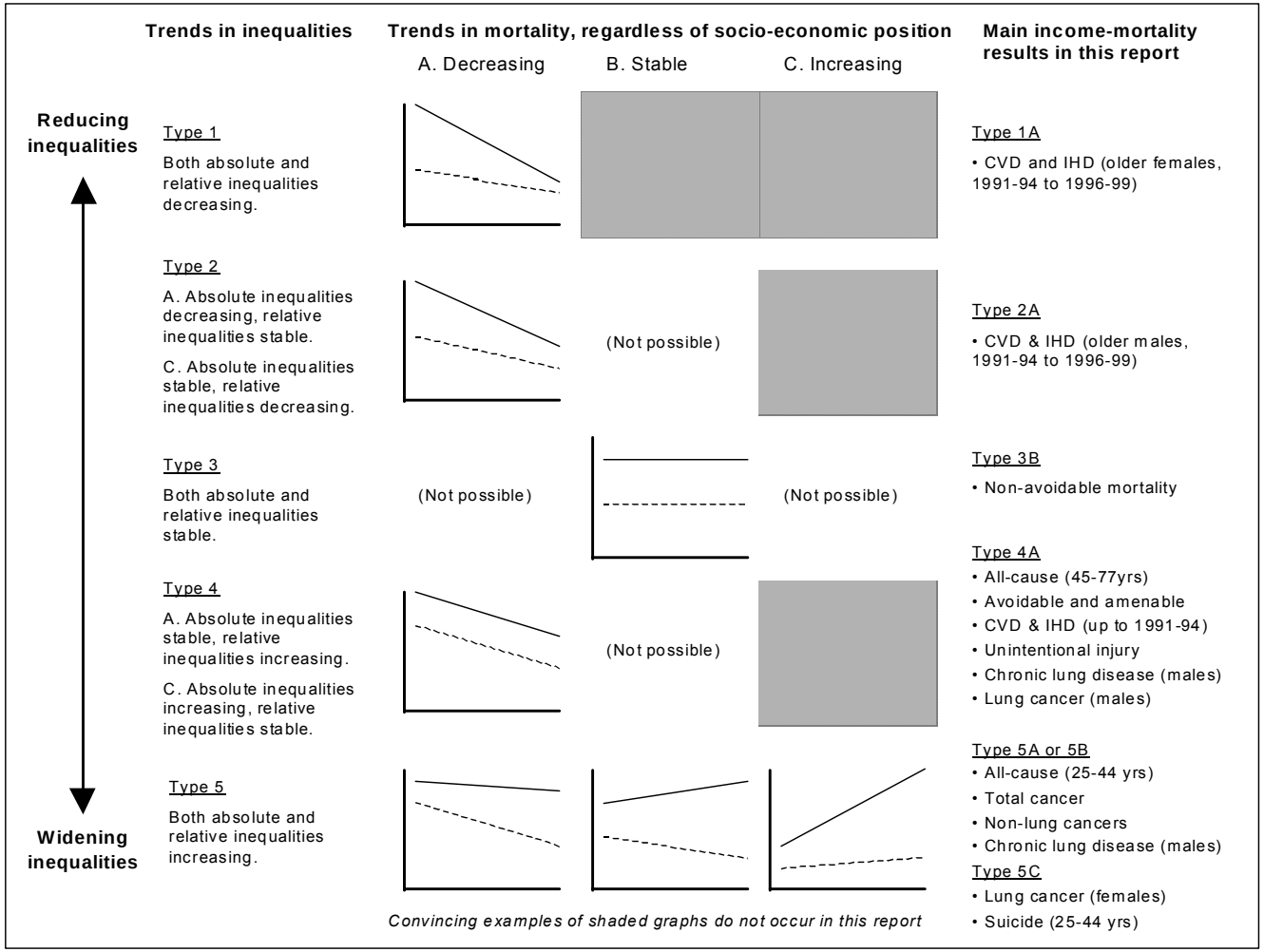
Wherever the emphasis is placed, trends in inequality are most usefully discussed with reference to the underlying differences in mortality trends between socioeconomic groups that give rise to changing patterns of inequality.

With regard to the trends in CVD inequality, this thesis shows increasing relative inequality, and constant absolute inequality in the context of substantial declines in overall CVD mortality. For the 45-59 and 60-77 year age groups the decline in CVD mortality was such that by 1991-94 mortality rates in the lower income and education groups were less than mortality rates in the high income and education groups ten years earlier in 1981-84. In this context there is no doubt that those in lower SEP groups had experienced substantial improvements in mortality and that the increase in relative inequality is driven by the decrease to very low level of the mortality rates of high SEP groups. Overemphasis on the increase in relative inequality belies the improvements in mortality for lower socioeconomic groups. Instead that low SEP groups achieved similar absolute levels of decline in CVD mortality is some cause for encouragement for health service providers.

In contrast among males aged 25-44 years those in low SEP groups showed no improvement in mortality over time, in contrast to high SEP groups. The resulting divergence in mortality rates produced increasing relative and absolute mortality measures. The clear difference in trajectories according to SEP must be interpreted as an increase in inequality that is likely to reflect inequalities in risk, as well as access to and uptake of primary and secondary prevention measures for both IHD and stroke. Reasons for the lack of uptake of preventive measures among young males in low SEP levels must critically address the effectiveness of health promotion and health service delivery to this at risk group.

Lung cancer presents another case whereby inequalities are clearly increasing in both relative and absolute terms. However the pattern of mortality trends by SEP level that has resulted in these patterns is different for males and females. For females, where lung cancer mortality is increasing overall, the increase in inequalities arises because it is only the low SEP groups that show an increase in mortality rates over the period of study. However for males, for whom overall lung cancer rates are decreasing, rates only decline for high SEP groups. The pattern of inequalities for lung cancer is consistent with an out of phase tobacco epidemic in which smoking was taken up first and then dropped first among high SEP groups and males.

Figure 10-3 A typology of trends in socio-economic inequalities in mortality, from reducing to widening inequalities with examples from the NZCMS analysis of inequalities by income Level



Source: Blakely (2004a). Although theoretically possible there are no examples from the NZCMS for the shaded options.

10.4.3 How do we interpret varying trends in inequality?

The results presented in this thesis show differences in trends in socioeconomic inequalities according to the measure of socioeconomic position, age, sex and cause of death. Because the strength of the association between socioeconomic position and mortality varies by cause of death, differences in socioeconomic inequality between subpopulations based on age and sex are to some extent explained by the relative importance of different causes of death within those populations. Similarly *trends* in the contribution of different causes to overall mortality are an important explanation of differences by age and sex in *trends* in overall mortality inequalities.

10.4.4 How do we interpret differences in trends for different socioeconomic measures?

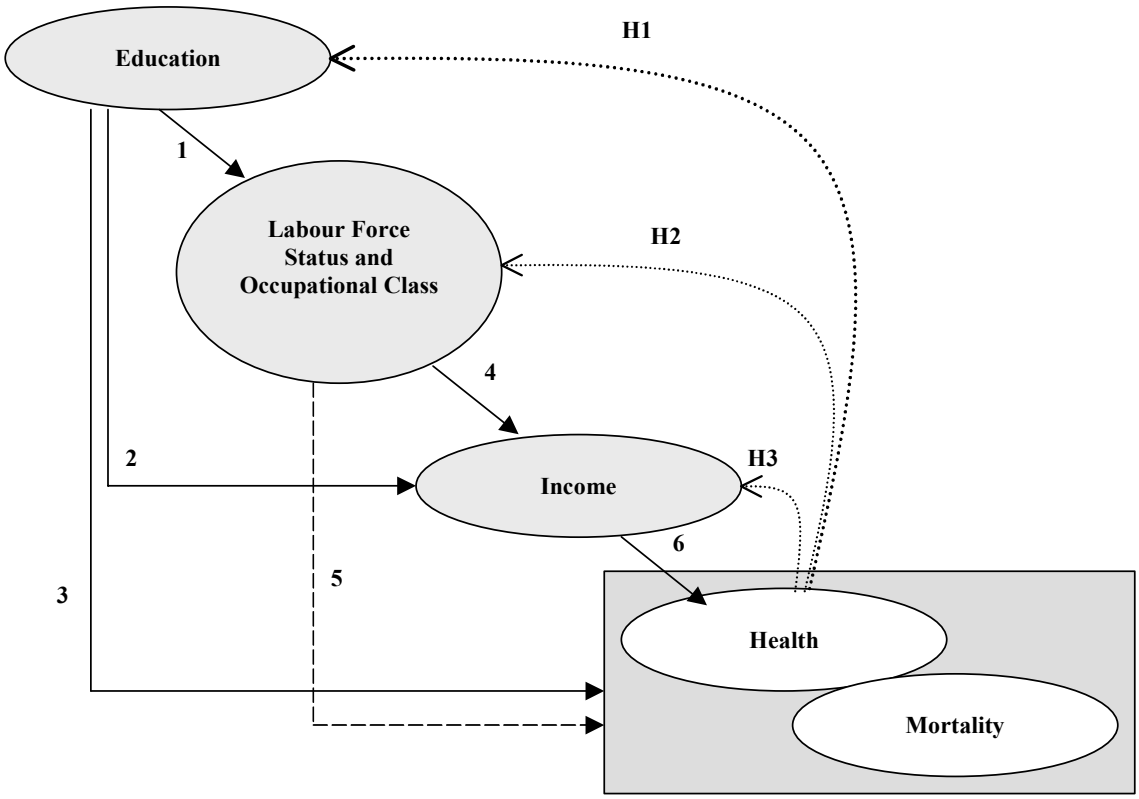
Both the size of the association of mortality with socioeconomic position and trends in those associations are different for income, educational and occupational class. To interpret these differences it is useful to return to the models for understanding the interrelationships between socioeconomic measures and to health and mortality outcomes.

Consider the model represented in Figure 10-4 that offers a simple framework for understanding the relationship between educational level, occupational class and income. By this schema the effect measures for education, reported in this thesis, are the total effect of education on mortality, which is mediated through the pathways represented by arrows 1,2 and 3. Arrow 3 represents all other pathways not mediated through pathways 1 and 2, including behavioural, environmental and psychosocial pathways. H1, H2 and H3 represent the effect of health on socioeconomic position. Education is the most distal measure of socioeconomic position. It is least affected by reverse causation, except in young adulthood, where health outcomes may influence education and subsequent social and economic trajectories.

Occupational Class measures are mediated through pathways 4 and 5. They are likely to be confounded to a degree by education but are particularly affected by movement in and out of the labour force, which is partly determined by health status (Health Selection). The interaction with labour force status and the impact of prior health status make disentangling the effects of occupational class and labour force status problematic, especially as labour

force status is likely to have an independent effect on health. The substantial, but varying, impact of differential health selection bias on the results by occupational class, make occupational class measures of little value for monitoring inequality trends in the New Zealand context.

Figure 10-4 Model linking educational level, occupational class and income to health and mortality



The effect measures for income (represented by arrow 6) are most subject to confounding by education and position in the labour market (occupational class and labour force status), but also by prior health status, accumulated through social and economic trajectories of poor health (H1, H2 and H3). If changes in the extent by which health affects socioeconomic position explain any of the observed increase in relative inequality then by this model we would expect the effect to be greater by income than by other socioeconomic measures. Indeed the results of this thesis suggest greater health selection may have been operating in the last cohort of the NZCMS series (section 6.3.2.2, page 219). Health affects income primarily by affecting the individuals ability to work (Deaton 2002), with the effect being most notable in the period prior to retirement.

Consider then the effect of age on the pathways from education to mortality. We know that education has become more predictive of position in the labour market (both in terms of occupational class and labour force status) for consecutive age cohorts in the later part of the 20th century (Maani 1997). Hence we might expect the association mediated through arrow 1 to vary with age. Furthermore education is likely to be most important at points of entry to the labour force, either initially or after periods out of employment.

Similarly the relationship between education and income level varies by age in ways not mediated through position in the labour market. For example education can be considered a marker of parental socioeconomic position, albeit imperfect. Individuals from wealthier backgrounds are more likely to have access to income sources apart from their labour market involvement. This may be particularly important at younger ages where, for example, parental assistance may help in acquiring assets. Third the effect of age on the arrow 3 pathway may vary by age depending on the risk factors for specific causes of death. For example changes in the prevalence of smoking at young ages mean that the risk of smoking related mortality is different for different age groups, furthermore cumulative exposure to tobacco smoke must increase with age. In a similar way all the downstream pathways are affected by age (arrows 4,5,6).

Corresponding scenarios can be built up to illustrate how different pathways might vary in importance according to sex and ethnicity. Changes in the relative importance of different pathways will also explain in part the observed trends in inequality.

In this thesis RII for both all cause and cardiovascular mortality were highest in the 25-44 years age group when measured by education but greatest in the 45-59 years age group when considered by income. One interpretation of these patterns is that education is a better predictor of life chances and future socioeconomic position than current income for young adults who may not have reached their full occupational status and earnings potential. However during later working life income may be a better measure of achieved socioeconomic position. At young ages education is also a more proximate measure of socioeconomic position but in older ages education has become a more distal measure, which may not reflect current socioeconomic position. The increased importance of educational qualification for labour market participation among younger cohorts may also mean that the greater strength of the education measures at young ages is to some extent due to a cohort effect that will only become evident with a longer time series.

10.4.5 How do we interpret differences in mortality inequality trends by cause of death?

The model used in the previous section to discuss the interpretation of differences in trends by socioeconomic measures, age and sex can be equally applied to the explanation for differences in trends in inequalities by cause of death. However rather than simply reapply the same framework by cause of death I flag three issues of importance for understanding the variations in trends by causes of death. In particular: the importance of specific risk factors for specific diseases; the importance of variations in latency or lag times; and the varying contribution of socioeconomic factors at different points in the disease process, from risk accumulation through to the point of death.

The extent to which known risk factors are patterned by socioeconomic position varies by cause of death and according to the strength of the associations between both socioeconomic position and risk factors and between risk factors and disease outcome. Consider for example tobacco smoking, a risk factor for a number of diseases. However the association of tobacco smoking with lung cancer and COPD is much stronger than for cardiovascular disease. Hence we might expect changes in the mechanisms by which socioeconomic factors affect trends in cardiovascular disease to be less direct than those for lung cancer or COPD.

Tobacco smoking is one risk factor that has been considered to a limited extent using the NZCMS data (Hill et al. 2003). Among cohort members aged 25-74 years the overall prevalence of current tobacco smoking fell, between 1981 and 1996, from 46% to 36% among males and from 29% to 23% among females (Hunt 2003: Table 8, page 69). Smoking rates were highest at low socioeconomic positions but also decreased proportionately less at low socioeconomic positions (Table 10-3). At the same time the effect of adjustment for socioeconomic position on the RR of mortality for smokers increased due to the increasing association of socioeconomic position with smoking. For females, adjustment for socioeconomic position causes the RR to reduce by 9% for 1981-84 compared to a 23% reduction in 1996-99; for males the RR reduced by 23% in 1981-84 and 33% in 1996-99 (Hunt 2003)(derived from Tables 21 and 22).

Table 10-3 Smoking Prevalence Rates by Socioeconomic Position, 1981 and 1996

SEP measure	SEP level	females			males		
		1981	1996	% change	1981	1996	% change
Income	High	29	19	-33%	32	20	-37%
	Medium	30	24	-21%	35	26	-25%
	Low	33	29	-14%	39	31	-20%
Education	High	22	16	-26%	27	19	-31%
	Medium	27	22	-19%	34	25	-25%
	Low	34	33	-4%	42	35	-17%

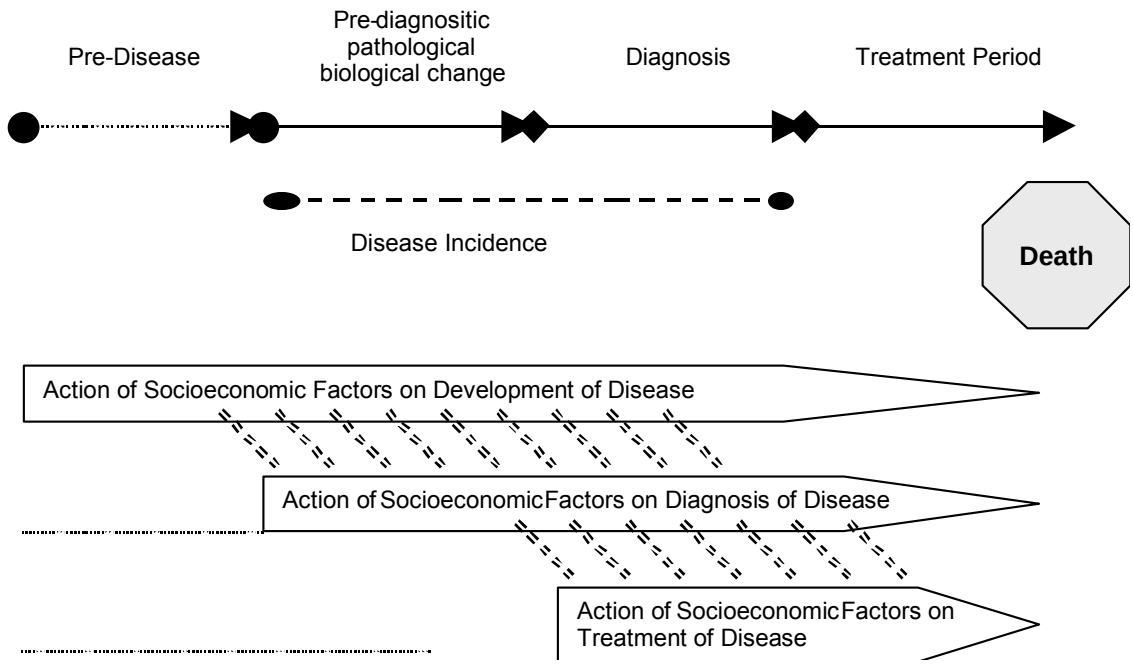
Source Adapted from Hill(2004a)

With the increased concentration of smokers in low socioeconomic positions we would expect greater increases in relative socioeconomic inequality for causes of death strongly associated with smoking. It is perhaps not surprising therefore to find the greatest increases in relative inequality occurred for lung cancer. Relative inequality for the total 25-77 year age group, by income, expressed in terms of the $PAR\%_{RII,}$ for females increased by 50% for lung cancer and 11% for CVD; and for males by 39% for lung cancer and 23% for CVD.

Differences in the measured effect of socioeconomic status for different causes are also influenced by the differences in latency or lag times between exposure and mortality outcomes. The lag effect of socioeconomic position is likely to be very short for deaths due to injury, somewhat longer for deaths due to cardiovascular disease (for which changes in diet and smoking, or access to treatments may influence outcomes over a relatively short period) and longer still for causes such as lung cancer.

Figure 10-5 suggests a simple model for considering the relative importance of socioeconomic influences at each stage of the disease process and provides another perspective by which to consider how trends in the socioeconomic inequalities vary by cause of death. For example, in the case of deaths due to accidents, the period of pre-disease exposure may be particularly important with regard to the individuals exposure to risky environments, or to alcohol consumption, but the period of pre-diagnostic biological change will be virtually non-existent. In a context where access to emergency care is free, the influence of socioeconomic factors during the period of diagnosis and treatment is likely to be mainly the consequence of area level socioeconomic processes that influence the availability and quality of emergency services.

Figure 10-5 Model illustrating the influence of socioeconomic factors at different stages of the disease process

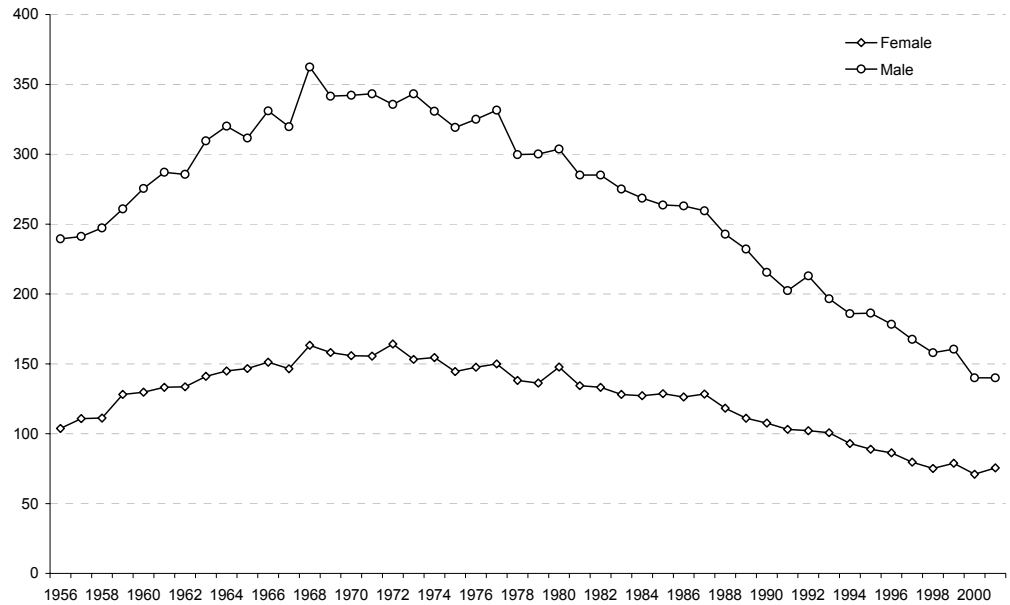


In contrast patterns of inequality in cardiovascular disease mortality are likely to arise at all points in the disease process. The pattern of increasing relative inequalities may therefore be influenced by factors prior to birth, through early adult risk factor exposures, uptake of preventative messages, access to early diagnosis, and the quality and the quantity of treatment services. Identification of the relative importance of socioeconomic inequalities at different points in the disease process provides an important perspective for understanding how trends in inequalities differ by causes of death but also for intervening to reduce inequalities for specific diseases.

10.4.5.1 The longer-term context of recent inequality trends.

In common with many countries mortality rates in New Zealand fell over the course of the 1980s and 1990s, with particularly pronounced falls in cardiovascular mortality. These declines must however be understood in the context of longer-term trends. New Zealand, in common with many westernised countries, experienced a dramatic increase in cardiovascular mortality from around the 1930s. High rates of mortality continued until the late 1960s when rates began to fall with particularly rapid declines from the mid-1980s onwards. The '*epidemic'* of cardiovascular mortality rates was particularly pronounced for males. (Figure 10-6)

Figure 10-6 IHD mortality trends 1955-2002



Source : Ministry of Health (personal communication)

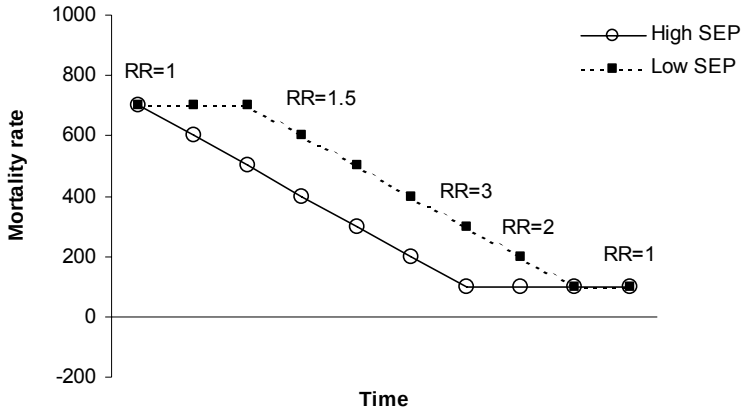
Trends described in this thesis show that the extent of mortality decline has been slower for less advantaged groups than their more socioeconomically advantaged compatriots. However how the pattern of social inequality in cardiovascular mortality developed in the early and mid twentieth century remains unclear. There is some contestable evidence that coronary heart disease rates among males were high among high status managerial occupations as well as unskilled labourers around 1960 (Copplestone and Rose 1967).

Victora et al (2000), based on the inverse equity hypothesis proposed by Hart (1971) theorised that more socioeconomically advantaged groups take-up public health programmes and interventions before less privileged groups. Furthermore low socio-economic groups will only catch up with high socio-economic groups once the latter have secured the maximum possible benefit from the new knowledge and initiatives. As a consequence, new interventions and technologies will cause relative inequalities in health and mortality to rise. As a consequence mortality rate decline, related to health interventions, will always occur later in low socioeconomic groups – as illustrated in Figure 10-7(a). Whether the less advantaged groups ever catch up or whether the mortality rates mortality rates among the low socio-economic group will plateau out at a higher level than more advantaged groups is likely to depend on the context and cause of death.

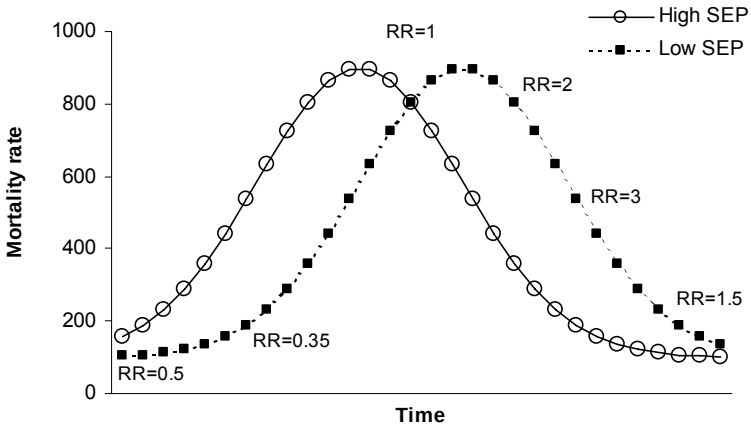
Although first developed as an explanation for trends in child mortality in South America th*e* inverse equity hypothesis provides a useful framework for considering trends in chronic diseases, including cardiovascular disease, in developed countries.

Figure 10-7 Scenarios of mortality rates trends for high and low socioeconomic groups.

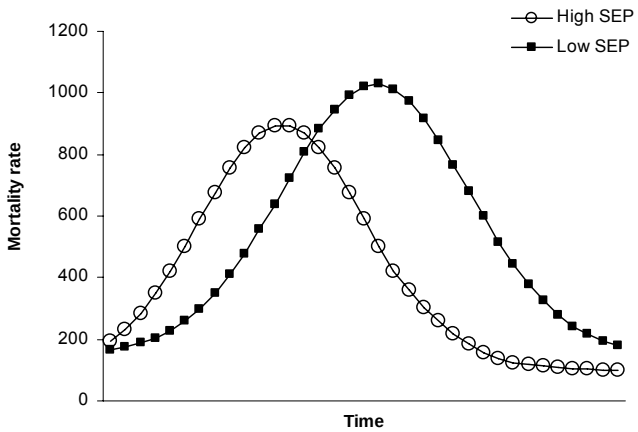
(a). Delayed Mortality Decline in Low SEP groups – the inverse equity hypothesis



(b). Mortality epidemics out of phase for high and low SEP groups



(c). Out of phase mortality epidemic for CVD – proposed model whereby the 'epidemic' more pronounced an longer lasting for Low SEP groups



Source adapted from Blakely (2004a)

Considering the CVD epidemic, Figure 10-7(a) could be considered as the end stage of a 'phased epidemic' – Figure 10-7(b) (Blakely et al. 2004a) By this scenario CVD mortality increases earliest in more advantaged groups as a result of the adoption of particular risk behaviours, including smoking and reduced fat consumption and the introduction of new treatments. However with increasing understanding of aetiology and the advent of treatments the advantaged group also benefits earlier from public health and medical interventions. Whilst the evidence that socioeconomically advantaged groups either adopted risk behaviours, or experienced higher CVD mortality earlier than other groups is scant there is some suggestive evidence. For example, in England and Wales medical doctors, a socioeconomically advantaged occupation, adopted tobacco smoking earlier than most occupational groups but were also among the earliest to quit (Doll et al. 2004). In New Zealand Māori were subject to higher smoking prevalence and have been later to quit (Hill et al. 2003)

The option presented in Figure 10-7(b) is perhaps too optimistic about the experience of low SEP groups. Figure 10-7(c) whereby the epidemic reaches greater heights and persists for longer among low SEP groups is likely to be more representative of the CVD epidemic in New Zealand. Indeed some groups (low income males aged 25-44 years) have yet to see a decline in mortality from IHD.

The models presented in Figure 10-7 also illustrates the dynamic interaction between absolute and relative inequality measures in the context of changing background mortality rates. However these models are inevitably a simplification of more complex patterns. In reality, multiple interventions are likely to be introduced at different points of time, with varying levels of coverage in different social groups (Victora et al. 2000). Placing recent trends in inequalities in a context of longer-term mortality trends provides a robust theoretical framework for understanding the evolving patterns of absolute and relative inequality.

The inverse equity hypothesis provides a useful lens by which to consider various explanations put forward to explain trends in socioeconomic inequality; including social and economic structural explanations, epidemiological (risk factor) explanations, psychosocial explanations and explanations about health service delivery.

10.4.5.2 Social and Economic structural explanations

The NZCMS data covers a period of rapid social and economic change. It has been suggested previously that economic restructuring in New Zealand may have contributed to a deterioration in life expectancy relative to Australia (O'Donoghue et al. 2000; Woodward et al. 2001) Yet the evidence for a link between wider structural reforms and socioeconomic inequalities in health outcomes is sparse.

There is however some suggestive evidence from the literature, and this thesis, that societal level structural change has contributed to widening socioeconomic inequalities in health and mortality. For example, unemployment is associated with suicide (Blakely et al. 2003b), hence increasing unemployment rates, as seen in New Zealand in the early 1990s might be expected to produce higher rates of suicide. Suicide rates did rise throughout the 1990s, but the rise continued well beyond the period of increasing unemployment. However, economic recovery was not spread evenly across the population, with the groups at high risk of suicide (young males form low socioeconomic positions, especially Māori) showing slower and later declines in unemployment. Thus inequalities in the extent of recovery from economic recession may have been increasing across the period, despite improvements in unemployment for the total population. This thesis found that these same groups showed no improvement in CVD mortality over the 1980s and 1990s.

The link between employment, an important component of structural change, and mortality outcomes is further supported by the emergence of strong mortality gradients by income and occupational class among females, where none existed previously, especially among women aged less than 60 years. Thus throughout the 1980s and 1990s, as females participation in the labour force increased substantially, the risk of mortality was increasingly associated with aspects of female workforce participation – that is, income and occupational class.

Thus it seems that the groups who showed little if any improvement in socioeconomic outcomes are also those among which substantial increases in mortality inequality were observed. However this evidence must be weighed against the evidence from this thesis that, despite earlier and more widespread economic restructuring, relative inequalities in mortality did not increase more in New Zealand than in Nordic countries. Many countries report increased relative socioeconomic inequalities, pointing to common elements in the pattern of mortality decline by socioeconomic position. The results reported here suggest

that if structural change has played a part in these inequalities, then the changes of importance are common to many western countries and were not amplified by the unique characteristics of the New Zealand politico-economic development.

Widening income distributions have been reported in many western countries over the later decades of the twentieth century. The widening income distribution contributed to the widening inequality in mortality by income in New Zealand. Had the relative size of the income categories in 1996 remained unchanged from that in 1981 the increase in the RII would have been approximately 25% less, although still substantial.

10.4.5.3 Epidemiological 'risk factor' explanations

It is hardly surprising that social inequalities are mediated to a large extent through the unequal distribution of disease risk factors. Hence we might expect that trends in risk factor distribution would influence trends in inequalities. Measuring the extent by which changing risk factor distribution explains increasing inequalities by socioeconomic position is complicated by need to take account of the variable time relationships between exposure variables and mortality outcomes. In practice most studies do not have the capacity to measure a wide variety of risk factors, all with different latencies, at the time most relevant for the action of that particular risk factor. Risk factors are inevitably misclassified in relation to the time of onset of disease and so the effect of changing risk factor levels is almost inevitably underestimated.

Some risk factors for cardiovascular disease showed a marked change in prevalence over the 1980s and 1990s. It has been estimated that declines in blood pressure, cholesterol and smoking together contributed about half the total decline in coronary heart disease mortality between 1982 and 1993 (Capewell et al. 2000). However, apart from smoking, little is known about the extent to which differential declines in cardiovascular risk factors contribute to the observed increases in relative socioeconomic inequalities in New Zealand. Increased clustering of risk factors in socioeconomically disadvantaged populations has been observed in a number of studies in the USA (Sharma et al. 2004; Tyroler 1999). However studies from Europe have found that the changes in risk factors do not explain, or only partly explain, the increasing social inequalities for cardiovascular mortality (Bartley et al. 2000; Vartiainen et al. 1998).

10.4.5.4 Psychosocial considerations

Although it is generally agreed that both psychosocial and material exposures are socially determined, there is continued debate as to whether it is access to material goods and political power and/or position in the psychosocial hierarchy that is important explaining the socioeconomic gradient in health (Muntaner 2004; Szreter and Woolcock 2004). While the nature and measurement of psychosocial factors continued to be debated the extent to which they contribute **to trends** in mortality is likely to be limited. Muntaner argues that "putative psycho-social risk factors are too dependent on changing economic, political and cultural structures to attain great generality across time and space" (Muntaner 2004: page 678).

Psychosocial theories provide useful links for understanding the biological mechanisms by which the social environment is embodied in health inequalities the contextual constraints in which psychosocial factors such as social capital, social networks, and social cohesion are defined limit their application of concepts in different periods and contexts. To be useful in explaining the trends in social inequality requires theoretical frameworks that more clearly integrate psychosocial factors with social, economic and political structures.

10.4.5.5 Health service explanations

The extent to which health care services contribute to social inequalities in health and mortality remains a source of contention. Arguments against the importance of health care centre around two themes. First that major improvements in life expectancy occurred prior to the introduction of effective preventive measures or treatments (Colgrove 1992; Link and Phelan 2002) and second that the socioeconomic gradient in health and mortality exists in all countries irrespective of the extent or reach of health services (Townsend et al. 1988).

However Deaton (2002) argues that while differential access to health care is unlikely to be the source of socioeconomic inequalities, public health literature understates both the effectiveness of health services and the potential for differential access to new technologies to generate a gradient where none existed before. The emergence of increasing socioeconomic inequalities in cancer mortality, observed in this thesis, has coincided with new advances in both cancer detection and treatment. It is perhaps not coincidental that these inequalities have arisen at the same time as growing uptake of screening for breast and cervical cancer. To untangle the contribution of health care to the growing inequalities

however requires more detailed studies of individual trajectories through health care services, with attention to not only access to health care but also the timeliness, type and quality of treatment.

Furthermore if as estimated approximately 50% of the decline in ischaemic heart disease mortality is due to more effective treatments (Capewell et al. 2000) there is ample scope for inequalities in treatment to contribute substantially to the increasing socioeconomic gradients.

10.5. What can we learn from international comparisons?

The original intention of this thesis was to include a broader range of countries in the international comparisons and to compare inequalities according to both education and EGP occupational class. However the amount of missing data for occupational class in the New Zealand made the comparisons of trends based on occupational data very tenuous and so these comparisons were dropped. Unfortunately the number of countries for which comparable education data was available was limited. The problems in obtaining comparable data however do illustrate the tenuous nature of many international comparisons. The focus of this report is in comparing trends. These comparisons of trends are likely to be more robust than the comparisons of actual levels of inequality. This is because comparability over time within countries is generally easier to achieve than comparability between countries.

The trend towards increasing relative inequality by education shown in this thesis is strikingly similar in all countries - including New Zealand when the data for the late 1990s are considered. By itself this observation is however only partial evidence for a general increase social inequalities. There is no doubt that education has become increasingly important as a determinant of access to stable high paying, high status occupations in many countries. As such it is likely to be an increasingly accurate measure of access to the determinants of good health and health care. Thus education is likely to be of growing importance as an axis of social inequality in many countries. The extent to which the observed increase in relative inequalities in mortality is a true measure of an underlying increase in socio-economic inequalities, or the consequence of education becoming a better measure of an underlying construct of socio-economic position, cannot be determined from these analyses.

Just as it is likely that education is becoming a stronger axis of inequality over time, the value of education as a measure of socio-economic position is likely to vary in different countries. Where a large proportion of the population has a low level of education, education is not very discriminating of socio-economic position across a large segment of the population. It is possible that higher levels of socioeconomic inequality will emerge with other measures of socio-economic position.

The New Zealand data demonstrates the importance of ethnicity as an independent determinant of both mortality and educational achievement in New Zealand. Mäori and Pacific ethnic groups comprise approximately one fifth of the New Zealand population, and the proportion has increased over time. Without standardisation by ethnicity levels of inequality in New Zealand exceed those in Europe, especially for females. This raises the possibility that inequalities measured in Europe may also be confounded by ethnicity, country of birth or other demographic factors prior to socio-economic position. The potential role of ethnicity, in the Nordic countries, is largest in Finland, with a distinction between Swedish and Finnish speaking populations. (Hyyppa and Maki 2001; Koskinen and Martelin 2003)

Standardisation for ethnicity reduced not only the magnitude of inequality measures but also the trends in inequality. Without ethnicity standardisation there is a much greater increase in relative inequality over time, suggesting an increasing association of ethnicity and mortality. The sub-populations that are disadvantaged by social and economic processes are likely to vary in different contexts. In New Zealand Māori and Pacific populations experienced greater increases in unemployment over the 1980s and early 1990s, and have shown lesser and later declines in unemployment with improved economic growth in the early 21st century. That New Zealand did not experience a greater increase in relative inequality by education may thus be because the increase in structural inequalities over the 1980s occurred primarily around a different axis of social inequality, that of ethnicity.

10.6. Policy Implications and Future Directions

Increasing relative socioeconomic inequalities in mortality points to an increasing concentration of mortality in low socioeconomic groups. This trend is particularly pronounced for CVD mortality, although not limited to it. For health service providers and policy makers, these trends provide a particular challenge to address the provision of health care for disadvantaged populations. Given the huge improvements in both primary and secondary treatment of cardiovascular diseases in the past twenty years, there is a particular need to address whether or not the improvement in technologies are reaching all sections of the population. As CVD mortality has increasingly become associated with socioeconomic disadvantage continued improvement in overall population mortality rates will be limited without effective interventions to reduce relative inequalities in CVD mortality.

That is not to say that both public health strategies, including both prevention and medical care, have not been effective strategies for population health. Huge overall declines in cardiovascular disease mortality have benefited all socioeconomic groups, except perhaps young males from low socioeconomic positions. Declining absolute gaps in CVD mortality for females and stable absolute gaps for men, point to the value of the effectiveness of these strategies. However as mortality declines to very low levels, as seen among high SEP females, effective interventions will need to be increasingly targeted to those who continue to be at risk.

Trends in CVD have been the main driver behind increasing life expectancy and, changes in absolute and relative inequality. However other causes of death made an increasing contribution to trends in inequality, especially in the 1990s. The emergence of increasing relative inequality for both lung cancer and other cancers (for example breast cancer and colorectal cancer) raises the issue as to the extent to differences in accesses to new technologies for the prevention, detection and treatment of cancers have contributed to these trends. Successful intervention to prevent or limit the widening of relative inequalities for cancer would be aided by research to identify the point(s) in the disease process at which these inequalities arise. Do the emerging inequalities reflect differences in incidence, access to primary care or differences in secondary treatment received by different socioeconomic groups? For example research considering differences in the stage of presentation of cancers

for different socioeconomic and ethnic groups might give some clues as to the most effective policy directions to reduce inequalities.

The observation that relative inequalities in mortality have increased for a wide range of important causes of death, point perhaps to generalised risks associated with socioeconomic position. In particular the clustering of risk factors - such smoking, obesity, poor diets, low physical activity levels, poor housing, stress and work environments - in socioeconomically disadvantaged populations, in addition to reduced access to primary and secondary care, and inequalities in treatment, are likely mechanisms that mediate the action of socioeconomic position on disease incidence and mortality for a wide range of diseases. Improved understanding of institutional and societal factors influencing health behaviours and access to health care in disadvantaged populations is required to ensure that public institutions contribute to social equality in health outcomes, rather than exacerbating inequalities. In order to develop effective mechanisms to intervene in reduce health inequalities requires a much more sophisticated understanding of the processes through which inequalities arise within the health system.

This thesis includes only a limited analysis of inequalities by ethnicity. It was not within the scope of this thesis to consider the interacting affect of ethnicity and socioeconomic position. However as discussed earlier the sections of the population that are disadvantaged by social and economic processes are likely to vary in different contexts. In New Zealand ethnicity is a powerful predictor of both socioeconomic and health outcomes. Furthermore strength of these associations increased over the 1980s and 1990s. Further analytical work addressing the interaction between socioeconomic status and ethnicity for mortality is a continued focus of the NZCMS. In particular, this work will address three questions:

1. Does the association of socioeconomic status and mortality vary by ethnicity?

4. How much of the observed ethnic variation in mortality is due to socioeconomic factors?

5. What is the public health impact of the ethnic variation in the socioeconomic gradient?

Monitoring trends in inequality is only the beginning of understanding the dynamic processes that produce and reproduce inequalities over time. CVD is an interesting case study because so much of the decline in mortality in recent years can be linked to health

promotion and health service activities. Unscrambling the contribution of health services to inequalities is of particular importance and points to an important line of future research. How do health providers ensure high quality services are effective and accessible for disadvantaged groups? The recent focus on reducing the cost of primary health care is an important recent step, but it is very simplistic to reduce access to an issue of cost. In particular more innovative approaches to delivering health care to young men at high risk are required.

There has at times been considerable debate about the direction of causality in the association of socioeconomic inequalities and health inequalities. Although the weight of evidence supports the contention that socioeconomic inequalities explain health inequalities to a much greater extent than health inequalities explain socioeconomic inequalities, the latter undoubtedly plays a part. There is a tentative suggestion, in this thesis, that the contribution of poor health to the association between income and mortality increased in the late 1990s. The effect of health on income and socioeconomic well-being in general can not be assumed to be constant, nor negligible. There is a need for greater understanding of the effects of poor health, and chronic illness and/or disability on social and economic outcomes. The extent of feedback from poor-health into the cycle of disadvantage and illness has important implications for government social support policies.

A major contribution of this thesis to our understanding of socioeconomic inequalities in New Zealand has been the development of methods for the systematic monitoring of socioeconomic inequalities in mortality using the NZCMS data. The dynamic nature of socioeconomic inequalities is a consequence of varying mortality trends for groups, defined according to various aspects of their social and economic location in New Zealand society. However the time trends presented here cover a relatively short period of time. The extension of the NZCMS study to cover later periods will add to our understanding of these dynamic trends, and help to identify emerging inequalities in New Zealand, as demonstrated for cancer mortality.

The utility of linking health data with other social data to provide new insights into social and health trends has been clearly demonstrated by this thesis. The transfer of this knowledge to other studies involving linkage between health data and other social datasets is a further priority for health inequalities research. For example; the future linkage between

the Study of Family Income and Employment and hospitalisation data and possible linkage between census and cancer registry data.

Chapter 11 References

Abercrombie, N., S. Hill and B.S. Taylor. 1994. *Penguin Dictionary of Sociology*. London: Penguin Group.

Adler, N. E., T. Boyce, M. A. Chesney, S. Cohen, S. Folkman, R. L. Kahn and S. L. Syme. 1994. "Socioeconomic status and health. The challenge of the gradient." *American Psychologist.* 49:15-24.

Adler, N. E. and J. M. Ostrove. 1999. "Socioeconomic status and health: what we know and what we don't." *Ann N Y Acad Sci* 896:3-15.

Ahmad, Omar B. , Cynthia Boschi-Pinto, Alan D. Lopez, Christopher J.L. Murray, Rafael Lozano and Mie. Inoue. "Age Standardization of Rates: A New WHO Standard." EIP/GPE/EBD World Health Organization.

Ajwani, S, T. A. Blakely, B Robson, M. Tobias and M Bonne. 2003. "Decades of Disparity: Ethnic mortality trends in New Zealand 1980-1999." Wellington: Ministry of Health and University of Otago.

Ajwani, S, T. A. Blakely, R. Robson, J. Atkinson, J.M. Fawcett and C. Kiro. 2002. "Estimating the Numerator-Denominator Bias for the 1980s and 1990s. NZCMS Technical Report No. 4." Wellington: Department of Public Health, Wellington School of Medicine and Health Sciences.

Altenderfer, M.E. 1947. "Relationship between per capita income and mortality in the cities of 100,000 or more population." *Public Health Rep. Washington* 62:1681 (cited in Antonovsky, 1968).

Anand, Sudhir, Finn Diderichsen, Timothy Evans, Vladimir M Shkolnikov and Meg Wirth. 2001. "Measuring disparities in Health: Methods and Indicators." Pp. 49-66 in *Challenging Inequities in Health from Ethics to Action*, edited by T. Evans, M. Whitehead, F. Diderichsen, A. Bhuiya and M. Wirth. new York: Oxford University Press.

Anderson, R. T., P. Sorlie, E. Backlund, N. Johnson and G. A. Kaplan. 1997. "Mortality effects of community socioeconomic status." *Epidemiology.* 8:42-7.

Antonovsky, A. 1967. "Social class, life expectancy and overall mortality." *Milbank Mem Fund Q* 45:31-73.

Antonovsky, A. 1968. "Social class and the major cardiovascular diseases." *J Chronic Dis* 21:65-106.

Arber, S. and E. Lahelma. 1993. "Inequalities in women's and men's ill-health: Britain and Finland compared." *Soc Sci Med* 37:1055-68.

Atkinson, A., L. Rainwater and T. Smeeding. 1995. "Income Distribution in OECD Countries, Evidence for the Luxembourg Income Study." Paris: OECD.

Avendano, M., A. E. Kunst, M. Huisman, F. van Lenthe, M. Bopp, C. Borrell, T. Valkonen, E. Regidor, G. Costa, A. Donkin, J. K. Borgan, P. Deboosere, S. Gadeyne, T. Spadea, O. Andersen and J. P. Mackenbach. 2004. "Educational level and stroke mortality: a comparison of 10 European populations during the 1990s." *Stroke.* 35:432-7.

Backlund, E., P. D. Sorlie and N. J. Johnson. 1999. "A comparison of the relationships of education and income with mortality: the National Longitudinal Mortality Study." *Soc Sci Med* 49:1373-84.

Baker, M., A. McNicholas, N. Garrett, N. Jones, J. Stewart, V. Koberstein and D. Lennon. 2000. "Household crowding a major risk factor for epidemic meningococcal disease in Auckland children." *Pediatric Infectious Disease Journal.* 19:983-90.

Barker, D J P. 2004. "Developmental origins of adult health and disease." *J Epidemiol Community Health* 58:114-115.

Barker, D J P, T Forsen, A Uutela, C Osmond and J G Eriksson. 2001. "Size at birth and resilience to effects of poor living conditions in adult life: longitudinal study." *BMJ* 323:1273-.

Barnett, E. and J. Halverson. 2001. "Local increases in coronary heart disease mortality among blacks and whites in the United States, 1985-1995." *Am J Public Health* 91:1499-506.

Barnett, E., D. Strogatz, D. Armstrong and S. Wing. 1996. "Urbanisation and coronary heart disease mortality among African Americans in the US South." *J Epidemiol Community Health* 50:252-7.

Bartley, M., R. Fitzpatrick, D. Firth and M. Marmot. 2000. "Social distribution of cardiovascular disease risk factors: change among men in England 1984-1993." *J Epidemiol Community Health* 54:806-14.

Bartley, M., C. Power, D. Blane, G. D. Smith and M. Shipley. 1994. "Birth weight and later socioeconomic disadvantage: evidence from the 1958 British cohort study." *BMJ* 309:1475-8.

Bazzano, L. A., J. He, L. G. Ogden, C. M. Loria, S. Vupputuri, L. Myers and P. K. Whelton. 2002. "Fruit and vegetable intake and risk of cardiovascular disease in US adults: the first National Health and Nutrition Examination Survey Epidemiologic Follow-up Study.[see comment]." *American Journal of Clinical Nutrition.* 76:93-9.

Beaglehole, R. 1990. "Variations in cardiovascular disease mortality by time and place: the challenge." *Aust N Z J Med* 20:636-8.

Beaglehole, R., D. R. Hay, F. H. Foster and D. N. Sharpe. 1981. "Trends in coronary heart disease mortality and associated risk factors in New Zealand." *N Z Med J* 93:371-5.

Beaglehole, R., A. W. Stewart, R. Jackson, A. J. Dobson, P. McElduff, K. D'Este, R. F. Heller, K. D. Jamrozik, M. S. Hobbs, R. Parsons and R. Broadhurst. 1997. "Declining rates of coronary heart disease in New Zealand and Australia, 1983-1993." *Am J Epidemiol* 145:707-13.

Belich, J. 2001. *Paradise Reforged: A History of the New Zealanders from the 1880s to the Year 2000.* Auckland: Penguin.

Bell, C., B. Swinburn, A. Stewart, R. Jackson, C. Tukuitonga and D. Tipene-Leach. 1996. "Ethnic differences and recent trends in coronary heart disease incidence in New Zealand." *N Z Med J* 109:66-8.

Bennett, S. 1996. "Socioeconomic inequalities in coronary heart disease and stroke mortality among Australian men, 1979-1993." *Int J Epidemiol* 25:266-75.

Ben-Shlomo, Yoav and Diana Kuh. 2002. "A life course approach to chronic disease epidemiology: conceptual models, empirical challenges and interdisciplinary perspectives." *Int J Epidemiol* 31:285-293.

Berkman, L. F. and I. Kawachi. 2000a. "A Historical Framework for Social Epidemiology." in *Social Epidemiology*, edited by L. F. Berkman and I. Kawachi. New York: Oxford University Press.

Berkman, L. F. and I. Kawachi. 2000b. "Social Epidemiology." New York: Oxford University Press.

Berkman, L. F. and Sally MacIntyre. 1997. "The measurement of social class in health studies: old measures and new formulations." in *Social Inequalities and Cancer.*, edited by M. Kogevinas, N. Pearce, M. Susser and P. Boffetta, IARC Scientific Publications No 138. Leon: International Agency for Research on Cancer.

Berkson, D.M., J. Stamler, H.A. Lindberg, W. Miller, H. Mathies, H. Lasky and Y. Hall. 1960. "Socioeconomic Correlates of Atherosclerotic and Hypertensive Heart Diseases." *Ann N Y Acad Sci* 84:835.

Blakely, T. A. 2001. "Socio-economic factors and mortality among 25-64 year olds:

The New Zealand Census-Mortality Study." in *Department of Public Health, Wellington School of Medicine and Health Sciences*. Wellington: University of Otago.

Blakely, T. A., J. Atkinson, C. Kiro, A. Blaiklock and A. D'Souza. 2003a. "Child mortality, socioeconomic position, and one-parent families: independent associations and variation by age and cause of death." *Int J Epidemiol* 32:410-8.

Blakely, T. A., S. C. Collings and J. Atkinson. 2003b. "Unemployment and suicide. Evidence for a causal association?[see comment]." *J Epidemiol Community Health* 57:594-600.

Blakely, T. A., J.M. Fawcett, J. Atkinson, M. Tobias and J. Cheung. 2004a. "Decades of Disparity II: Socio-economic Mortality Trends in New Zealand. 1981-1999. Public Health Intelligience Occassional Bulletin Number 24." Wellington: Ministry of Health.

Blakely, T. A., I Kawachi, J. Atkinson and J.M. Fawcett. 2004b. "Income and mortality: the shape of the association and confounding New Zealand Census-Mortality Study, 1981-1999." *Int J Epidemiol* 33:874-883.

Blakely, T. A., C. Kiro and A. Woodward. 2002a. "Unlocking the numerator-denominator bias. II: Adjustments to mortality rates by ethnicity and deprivation during 1991-94. The New Zealand Census-Mortality Study." *N Z Med J* 115:43-8.

Blakely, T. A., C Salmond and A Woodward. 1999. "Anonymous record linkage of 1991 census records and 1991-94 mortality records: The New Zealand Census-Mortality Study." in *(Also at http://www.wnmeds.ac.nz/nzcms-info.htm)*. Wellington: Department of Public health, Wellington School of Medicine, University of Otago.

Blakely, T. A. and C. Salmond. 2002. "Probabilistic record linkage and a method to calculate the positive predictive value." *Int J Epidemiol* 31:1246-52.

Blakely, T. A., M Tobias, B Robson, S Ajwani, M Bonne and A. Woodward. in press. "Widening ethnic mortality disparities in New Zealand, 1981-99." *Soc Sci Med*.

Blakely, T. A., A. Woodward, N. Pearce, C. Salmond, C. Kiro and P. Davis. 2002b. "Socio-economic factors and mortality among 25-64 year olds followed from 1991 to 1994: the New Zealand Census-Mortality Study." *N Z Med J* 115:93-7.

Blane, D. 1999. "The life-course the social gradient, and health." Pp. 64-81 in *Social Determinants of Health*, edited by M. Marmot and R. G. Wilkinson. New York: Oxford University Press.

Blane, D. 2001. "Commentary: Socioeconomic health differentials." *Int J Epidemiol* 30:292-3.

Blane, D., G Davey Smith and M. Bartley. 1993. "Social selection: what does it contribute to social class differences in health." *Sociology of Health and Illness* 15:1-15.

Bopp, Matthias and Christoph E Minder. 2003. "Mortality by education in German speaking Switzerland, 1990-1997: results from the Swiss National Cohort." *Int J Epidemiol* 32:346-354.

Borrell, C., A. Plasencia, I. Pasarin and V. Ortun. 1997. "Widening social inequalities in mortality: the case of Barcelona, a southern European city." *Journal of Epidemiology & Community Health.* 51:659-67.

Bosma, H., H. D. van de Mheen, G. J. Borsboom and J. P. Mackenbach. 2001. "Neighborhood socioeconomic status and all-cause mortality." *Am J Epidemiol* 153:363-71.

Boston, J, P Dalziel and S. John. 1999. *Redesigning the Welfare State in New Zealand: Problems, Policies and Prospects.* Auckland: Oxford University Press.

Bremberg, S. 2003. "Does an increase of low income families affect child health inequalities? A Swedish case study." *J Epidemiol Community Health* 57:584-588.

Breslow, L. and P. Buell. 1960. "Mortality from coronary heart disease and physical activity of work in California." *J Chronic Dis* 11:421.

Brunner, E. and M G Marmot. 1999. "Social Organization, stress and health." in *Social Determinants of Health*, edited by M. G. Marmot and R. G. Wilkinson. Oxford: Oxford University Press.

Brunner, E., M. J. Shipley, D. Blane, G. D. Smith and M. G. Marmot. 1999. "When does cardiovascular risk start? Past and present socioeconomic circumstances and risk factors in adulthood." *J Epidemiol Community Health* 53:757-64.

Burnley, I. H. 1998. "Inequalities in the transition of ischaemic heart disease mortality in New South Wales, Australia, 1969-1994." *Soc Sci Med* 47:1209-22.

Capewell, Simon, Robert Beaglehole, Mary Seddon and John McMurray. 2000. "Explanation for the Decline in Coronary Heart Disease Mortality Rates in Auckland, New Zealand, Between 1982 and 1993." *Circulation* 102:1511-1516.

Casper, Michele L., Steve Wing, Robert F. Anda, Marilyn Knowles and Robert A. Pollard. 1995. "The Shifting Stroke Belt : Changes in the Geographic Pattern of Stroke Mortality in the United States, 1962 to 1988." *Stroke* 26:755-760.

Cassel, J. 1976. "The contribution of the social environment to host resistance: the Fourth Wade Hampton Frost Lecture." *Am. J. Epidemiol.* 104:107-123.

Chandola, T., M. Bartley, A. Sacker, C. Jenkinson and M. Marmot. 2003a. "Health selection in the Whitehall II study, UK." *Soc Sci Med* 56:2059-72. 2: Chandola T et al. Social inequalities in health...[PMID: 12490650]Related Articles, Links.

Chandola, T., M. Bartley, R. Wiggins and P. Schofield. 2003b. "Social inequalities in health by individual and household measures of social position in a cohort of healthy people." *J Epidemiol Community Health* 57:56-62. 3: Jenkinson C et al. Patients' experiences and sat...[PMID: 12468693]Related Articles, Links.

Cohen, Sheldon, Natalie Hamrick, Mario S. Rodriguez, Pamela J. Feldman, Bruce S. Rabin and Stephen B. Manuck. 2002. "Reactivity and Vulnerability to Stress-Associated Risk for Upper Respiratory Illness." *Psychosom Med* 64:302-310.

Colgrove, J. 1992. "The McKeown thesis: a historical controversy and its enduring influence." *Am J Public Health* 92:725-729.

Coombs, L.C. 1941. "Economic differentials in causes of death." *Med Care* 1.

Cooper, R., J. Cutler, P. Desvigne-Nickens, S. P. Fortmann, L. Friedman, R. Havlik, G. Hogelin, J. Marler, P. McGovern, G. Morosco, L. Mosca, T. Pearson, J. Stamler, D. Stryer and T. Thom. 2000. "Trends and disparities in coronary heart disease, stroke, and other cardiovascular diseases in the United States: findings of the national conference on cardiovascular disease prevention." *Circulation* 102:3137-47.

Copplestone, J. F. and R. J. Rose. 1967. "Occupational mortality among male population, other than maori, 20 to 64 years of age. Based on deaths 1959-63 and population census 1961." Wellington: National Health Statistics Centre Department of Health.

Crampton, P. 1997. "NZDep91 A New Index of Deprivation." *Social Policy Journal of New Zealand* 9:186-193.

Crampton, P. and C Salmond. 1999. "Deprivation and Health." in *Social Inequalities in Health*, edited by Ministry of Health. Wellington: Ministry of Health.

Dahl, E. and P. Kjaersgaard. 1993. "Trends in socioeconomic mortality differentials in post-war Norway: evidence and interpretations." *Sociology of Health and Illness* 15:587-611.

Dahlgren, G. and M. Whitehead. 1991. *Policies and Strategies to Promote Equity in Health*. Copenhagen: World Health Organisation Regional Office for Europe.

Dalstra, J A A, A E Kunst, J J M Geurts, F J M Frenken and J P Mackenbach. 2002. "Trends in socioeconomic health inequalities in the Netherlands, 1981-1999." *J Epidemiol Community Health* 56:927-934.

Davey Smith, G. 1997. "Socioeconomic Differentials." Pp. 242-273 in *A Life Course approach to Chronic Disease Epidemiology*, edited by D. Kuh and Y. Ben-Shlomo. Oxford: Oxford University Press.

Davey Smith, G, D Dorling, R Mitchell and M Shaw. 2002. "Health inequalities in Britain: continuing increases up to the end of the 20th century." *J Epidemiol Community Health* 56:434-435.

Davey Smith, G. 2000. "Learning to live with complexity: ethnicity, socioeconomic position, and health in Britain and the United States." *Am J Public Health* 90:1694-8.

Davey Smith, G., David Gunnell and Yoav Ben-Shlomo. 2000. "Life course approaches to socioeconomic differentials in cause-specific adult mortality." in *Poverty Inequality and Health: an international perspective*, edited by D. A. Leon and G. Walt.

Davey Smith, G. and C. Hart. 1998. "Socioeconomic factors and determinants of mortality." *Jama* 280:1744-5.

Davey Smith, G., C. Hart, D. Blane, C. Gillis and V. Hawthorne. 1997. "Lifetime socioeconomic position and mortality: prospective observational study." *Bmj* 314:547-52.

Davey Smith, G., C. Hart, G. Watt, D. Hole and V. Hawthorne. 1998. "Individual social class, area-based deprivation, cardiovascular disease risk factors, and mortality: the Renfrew and Paisley Study." *J Epidemiol Community Health* 52:399-405.

Davis, P., K. McLeod, M. Ransom, P. Ongley, N. Pearce and P. Howden-Chapman. 1999. "The New Zealand Socioeconomic Index: developing and validating an occupationally-derived indicator of socio-economic status." *Aust N Z J Public Health* 23:27-33.

Davis, Peter , Gabrielle Jenkin and Pat Coope. 2002. "New Zealand Socio-economic Index 1996 An update and revision of the New Zealand Socio-economic Index of Occupational Status." Wellington: Statistics New Zealand.

Deaton, A. 2002. "Policy implications of the gradient of health and wealth. An economist asks, would redistributing income improve population health?" *Health Aff (Millwood)* 21:13-30.

Department of Social Welfare. 1999. "Social Environment Scan." Wellington: Department of Social Welfare, Social Policy Agency.

Diaz, R. M., G. Ayala, E. Bein, J. Henne and B. V. Marin. 2001. "The impact of homophobia, poverty, and racism on the mental health of gay and bisexual Latino men: findings from 3 US cities." *Am J Public Health* 91:927-32.

Diderichsen, F and J Hallqvist. 1997. "Trends in occupational mortality among middle-aged men in Sweden 1961- 1990." *Int J Epidemiol* 26:782-787.

Doll, R. and P. Cook. 1967. "Summarizing indices for comparison of cancer incidence data." *Int. J. Cancer* 2:269-79.

Doll, Richard, Richard Peto, Jillian Boreham and Isabelle Sutherland. 2004. "Mortality in relation to smoking: 50 years' observations on male British doctors." *BMJ* 328:1519-0.

Draper, G., G. Turrell and B. Oldenburg. 2004. "Health Inequalities in Australia: Mortality. Health Inequalities Monitoring Series No. 1.,." Canberra: Queensland University of Technology and the Australian Institute of Health and Welfare.

Easton, BH. 1997. *The commercilization of New Zealand*. Auckland: Auckland University Press.

Easton, BH and S Ballentyne. 2002. "Household Equivalence Scales." in *The Health and Economic Status of Households*.

Elley, W. B. and J. C. Irving. 1976. "Revised Socio-Economic Index for New Zealand." *NZ J Educ. Stud* 11:25-30.

Ellis, J. 1958. "Socio-economic differentials in mortality from chronic disease." *Social Problems* 5.

Elstad, J. I. and S. Krokstad. 2003. "Social causation, health-selective mobility, and the reproduction of socioeconomic health inequalities over time: panel study of adult men." *Soc Sci Med* 57:1475-89.

Esping-Andersen, Gosta. 1999. *Social Foundations of Postindustrial Societies*. Oxford: Oxford University Press.

Fawcett, J.M., T. A. Blakely and J. Atkinson. 2002. "Weighting the 81, 86, 91 & 96 Census-Mortality Cohorts to adjust for Linkage Bias. NZCMS Technical Report No. 5." Wellington: Department of Public Health, Wellington School of Medicine and Health Sciences.

Feinstein, J. S. 1993. "The relationship between socioeconomic status and health: a review of the literature." *Milbank Q* 71:279-322.

Feldman, J. J., D. M. Makuc, J. C. Kleinman and J. Cornoni-Huntley. 1989. "National trends in educational differentials in mortality." *Am J Epidemiol* 129:919-33.

Filakti, H. and J. Fox. 1995. "Differences in mortality by housing tenure and by car access from the OPCS Longitudinal Study." *Popul Trends*:27-30.

Fox, A. J., P. O. Goldblatt and D. R. Jones. 1985. "Social class mortality differentials: artefact, selection or life circumstances?" *J Epidemiol Community Health* 39:1-8.

Fox, AJ and PO Goldblatt. 1982. "Longitudinal Study 1971-1975: Socio-demographic mortality differences." London: Her Majesty's Stationary Office: Office of Population Censuses and Surveys.

Fuhrer, R., M. J. Shipley, J. F. Chastang, A. Schmaus, I. Niedhammer, S. A. Stansfeld, M. Goldberg and M. G. Marmot. 2002. "Socioeconomic position, health, and possible explanations: a tale of two cohorts." *Am J Public Health* 92:1290-4.

Galobardes, Bruna, John W. Lynch and George Davey Smith. 2004. "Childhood Socioeconomic Circumstances and Cause-specific Mortality in Adulthood: Systematic Review and Interpretation." *Epidemiol Rev* 26:7-21.

Gibberd, R. W., A. J. Dobson, C. D. Florey and S. R. Leeder. 1984. "Differences and comparative declines in ischaemic heart disease mortality among subpopulations in Australia, 1969-1978." *Int J Epidemiol* 13:25-31.

Giddens, Anthony. 1989. *Sociology*. Cambridge, UK: Polity Press.

Goldblatt, P. 1989. "Mortality by social class, 1971-85." *Population Trends* 56:6-15.

Graham, H. 2002. "Building an inter-disciplinary science of health inequalities: the example of lifecourse research." *Soc Sci Med* 55:2005-16.

Guralnick, L. 1963. "Socioeconomic differences in mortality by cause of death: United States 1950 and England and Wales 1949-1953." Pp. 287-313 in *International Population Conference*, edited by International Union for the scientfic study of population. Ottawa: Liege.

Haan, M., G. A. Kaplan and T. Camacho. 1987. "Poverty and health. Prospective evidence from the Alameda County Study." *Am J Epidemiol* 125:989-98.

Harding, S. 1995. "Social class differences in mortality of men: recent evidence from the OPCS Longitudinal Study. Office of Population Censuses and Surveys." *Popul Trends*:31-7.

Harlan, William. 1989. "CHD Trends in the United States: Overview." *Int J Epidemiol* 18 (Suppl 1):556-557.

Hart, C., R. Ecob and G. D. Smith. 1997. "People, places and coronary heart disease risk factors: a multilevel analysis of the Scottish Heart Health Study archive." *Soc Sci Med* 45:893-902.

Hart, C. L., G. D. Smith and D. Blane. 1998. "Social mobility and 21 year mortality in a cohort of Scottish men." *Soc Sci Med* 47:1121-30.

Hart, J.T. 1971. "The inverse care law." *Lancet* 1:405-412.

Hattersley, L. 1997. "Expectation of life by social class." in *Health Inequalities*, edited by F. Drever and M. Whitehead. London: Series TS15 TSO.

Hattersley, L and R Creeser. 1995. "Longitudinal Study 1971-1991 History, organisation and quality of data." London: Office of Population Censuses and Surveys.

Hattersley, L and Office for National Statistics. 1999. "Trends in life expectancy by social class - an update." *Health Statistics Quarterly*:16-24.

Hayes, L J and G Berry. 2002. "Sampling variability of the Kunst-Mackenbach relative index of inequality." *J Epidemiol Community Health* 56:762-765.

Hayes, L. J., S. Quine, R. Taylor and G. Berry. 2002. "Socio-economic mortality differentials in Sydney over a quarter of a century, 1970-94." *Aust N Z J Public Health* 26:311-7.

Hedley, O.F. 1939. "Analysis of 5116 deaths reported as due to acute coronary occlusion in Philadelphia. 1933-1937." *Public Health Rep. Washington* 54:972 (cited in Antonovsky, 1968).

Hennekens, Charles H and Julie E Buring. 1987. "Epidemiology in Medicine." edited by S. L. Mayrent. Boston: Little, Brown and company.

Hernàn, M. A., S. Hernandez-Diaz and J. M. Robins. 2004. "A Structural approach to selection bias." *Epidemiology* 15:615-625.

Higgins, M. and T. Thom. 1989. "Trends in CHD in the United States." *Int J Epidemiol* 18:S58-66.

Higgins, M. and T. Thom. 1993. "Trends in stroke risk factors in the United States." *Ann Epidemiol* 3:550-4.

Hill, S., J. Atkinson and T. A. Blakely. 2002. "Record linkage of 1981, 1986, 1991, 1996 census records to mortality records. NZCMS Technical Report No. 3. (Also at http://www.wnmeds.ac.nz/nzcms-info.html)." Wellington: Department of Public Health, Wellington School of Medicine and Health Sciences, University of Otago.

Hill, S., T. A. Blakely, J.M. Fawcett and P. Howden-Chapman. 2004a. "Could mainstream anti-smoking programmes increase inequalities in tobacco use? New Zealand data from 1981-1996." *Aust N Z J Public Health* 29:279-84.

Hill, S., T. A. Blakely and P. Howden-Chapman. 2003. "Smoking Inequalities policies and patterns of tobacco use in New Zealand, 1981-1996 Public Health Monograph Series

No. 11." Wellington: Department of Public Health, Wellington School of Medicine & Health Sciences, University of Otago.

Hill, S., T. A. Blakely, I Kawachi and A Woodward. 2004b. "Mortality among "never smokers" living with smokers: two cohort studies, 1981-4 and 1996-9." *BMJ* 328:988-989.

Hogstedt, C. and I. Lundberg. 2003. "Work-Related Policies and Interventions." in *Reducing Inequalities in Health A European Perspective*, edited by J. P. Mackenbach and M. Bakker. London: Routledge.

Huisman, M, A E Kunst, O Andersen, M Bopp, J-K Borgan, C Borrell, G Costa, P Deboosere, G Desplanques, A Donkin, S Gadeyne, C Minder, E Regidor, T Spadea, T Valkonen and J P Mackenbach. 2004. "Socioeconomic inequalities in mortality among elderly people in 11 European populations." *J Epidemiol Community Health* 58:468-475.

Huisman, M., A. E. Kunst and J. P. Mackenbach. 2003. "Socioeconomic inequalities in morbidity among the elderly; a European overview." *Soc Sci Med* 57:861-73.

Hunt, D. 2003. "Mortality from Smoking in New Zealand. The association between cigarette smoking and mortality from all-causes, ischaemic heart disease and stroke in New Zealanders aged 25-74 years, 1981-1984 and 1996-1999." in *Department of Public Health, Wellington School of Medicine and Health Sciences*. Wellington: Otago.

Hyyppa, Markku T. and Juhani Maki. 2001. "Why do Swedish-speaking Finns have longer active life? An area for social capital research." *Health Promot. Internation.* 16:55-64.

Illsley, R. 1990. "Health inequities in Europe. Comparative review of sources, methodology and knowledge." *Soc Sci Med* 31:229-36.

Illsley, R. and D. Baker. 1991. "Contextual variations in the meaning of health inequality." *Soc Sci Med* 32:359-65.

Jensen, J. 1978. *Minimum Income Levels and Income Equivalisation Scales.* Wellington: Department of Social Welfare.

Jensen, J. 1988. *Income Equivalences and the Estimation of Family Expenditure on Children*. Wellington: Department of Social Welfare (unpublished).

Jones, D. W., C. T. Sempos, T. J. Thom, A. M. Harrington, H. A. Taylor, Jr., B. W. Fletcher, B. D. Mehrotra, S. B. Wyatt and C. E. Davis. 2000. "Rising levels of cardiovascular mortality in Mississippi, 1979-1995." *Am J Med Sci* 319:131-7.

Kagamimori, S., Y. Iibuchi and J. Fox. 1983. "A comparison of socioeconomic differences in mortality between Japan and England and Wales." *World Health Stat Q* 36:119-28.

Kaplan, G. A., E. R. Pamuk, J. W. Lynch, R. D. Cohen and J. L. Balfour. 1996. "Inequality in income and mortality in the United States: analysis of mortality and potential pathways." *Bmj* 312:999-1003.

Kaplan, G., M. Haan, S. L. Syme, M. Minkler and M. Winkleby. 1987. "Socioeconomic Status and Health." Pp. 125-129 in *Closing the gap: the burden of unnecessary illness*, edited by R. W. Amler and H. B. Dull. New York: Oxford University Press.

Kaplan, GA and JE Keil. 1993. "Socioeconomic factors and cardiovascular disease: a review of the literature." *Circulation* 88:1973-1998.

Karlsen, S. and J. Y. Nazroo. 2002. "Relation between racial discrimination, social class, and health among ethnic minority groups." *Am J Public Health* 92:624-31.

Kawachi, I and L. F. Berkman. 2000. "Social cohesion, social capital, and health." in *Social Epidemiology*, edited by L. F. Berkman and I. Kawachi. New York: Oxford University Press.

Kawachi, I, S V Subramanian and N Almeida-Filho. 2002. "A glossary for health inequalities." *J Epidemiol Community Health* 56:647-652.

Kawachi, I. and L. F. Berkman. 2003. "Neighbourhoods and Healh." New York: Oxford University Press.

Kawachi, I., S. Marshall and N. Pearce. 1991. "Social class inequalities in the decline of coronary heart disease among New Zealand men, 1975-1977 to 1985-1987." *Int J Epidemiol* 20:393-8.

Kennedy, B. P., I. Kawachi and D. Prothrow-Stith. 1996. "Income distribution and mortality: cross sectional ecological study of the Robin Hood index in the United States." *Bmj* 312:1004-7.

Kitagawa, E. M. and P. M. Hauser. 1963. "Social and Economic Differentials in Mortality in the United States, 1960. A report on methods." Pp. 355-367 in *International Population Conference*, edited by International Union for the scientfic study of population. Ottawa: Liege 1964.

Kitagawa, E. M. and P. M. Hauser. 1973. *Differential Mortality in the United States: A study of Socioeconomic Epidemiology*. Cambridge, Mass: Harvard University Press.

Kjelsberg, M. and J. Stamler. 1960. "Epidemiologic studies on cardiovascular-renal diseases: II. Analysis of mortality by age-race-sex-place of residence, including urban-rural comparisons." *Journal of Chronic Diseases.* 12:456-63.

Koskinen, S. and T. Martelin. 1994. "Why are socioeconomic mortality differences smaller among women than among men?" *Soc Sci Med* 38:1385-96.

Koskinen, S. and T. Martelin. 2003. "Why is mortality low among the Swedish - speaking minority in Finland?" *Yearbook of Population Research in Finland* 38:15-32.

Krieger, N. 2000. "Discrimination and Health." Pp. 36-75 in *Social Epidemiology*, edited by L. F. Berkman and I. Kawachi. New York: Oxford University Press.

Krieger, N. 2001a. "A glossary for social epidemiology." *J Epidemiol Community Health* 55:693-700.

Krieger, N. 2001b. "Theories for social epidemiology in the 21st century: an ecosocial perspective." *Int J Epidemiol* 30:668-77.

Krieger, N. 2003. "Does racism harm health? Did child abuse exist before 1962? On explicit questions, critical science, and current controversies: an ecosocial perspective." *Am J Public Health* 93:194-9.

Krieger, N., D. L. Rowley, A. A. Herman, B. Avery and M. T. Phillips. 1993. "Racism, sexism, and social class: implications for studies of health, disease, and well-being." *Am J Prev Med* 9:82-122.

Krieger, N., D. R. Williams and N. E. Moss. 1997. "Measuring social class in US public health research: concepts, methodologies, and guidelines." *Annu Rev Public Health* 18:341-78.

Krieger, Nancy and George Davey Smith. 2004. ""Bodies Count," and Body Counts: Social Epidemiology and Embodying Inequality." *Epidemiol Rev* 26:92-103.

Kuh, D, Y Ben-Shlomo, J Lynch, J Hallqvist and C Power. 2003. "Life course epidemiology." *J Epidemiol Community Health* 57:778-783.

Kuh, D. and G. D. Smith. 1993. "When is mortality risk determined? Historical insights into a current debate." *Soc Hist Med* 6:101-23.

Kuh, Diana and Yoav Ben-Shlomo. 1997. "A Life Course approach to Chronic Disease Epidemiology." Oxford: Oxford University Press.

Kunst, A E, V. Bos, J P Mackenbach and EU Working Group on Socio-Economic Inequalities In Health. 2000. "Measuring socio-economic inequalities in health in the European Union: guidelines and illustrations." Rotterdam: Department of Public Health Erasmus University.

Kunst, A. E. 1997. "Cross-national comparisons of socio-economic differences in mortality." Pp. 264 in *Department of Public Health*. Rotterdam: Erasmus University.

Kunst, A. E., M. del Rios, F. Groenhof and J. P. Mackenbach. 1998a. "Socioeconomic inequalities in stroke mortality among middle-aged men: an international overview. European Union Working Group on Socioeconomic Inequalities in Health." *Stroke* 29:2285-91.

Kunst, A. E., F. Groenhof, O. Andersen, J. K. Borgan, G. Costa, G. Desplanques, H. Filakti, Md Giraldes, F. Faggiano, S. Harding, C. Junker, P. Martikainen, C. Minder, B. Nolan, F. Pagnanelli, E. Regidor, D. Vagero, T. Valkonen and J. P. Mackenbach. 1999. "Occupational class and ischemic heart disease mortality in the United States and 11 European countries." *Am J Public Health* 89:47-53.

Kunst, A. E., F. Groenhof, J. K. Borgan, G. Costa, G. Desplanques, F. Faggiano, O. Hemstrom, P. Martikainen, D. Vagero, T. Valkonen and J. P. Mackenbach. 1998b. "Socio-economic inequalities in mortality. Methodological problems illustrated with three examples from Europe." *Rev Epidemiol Sante Publique* 46:467-79.

Kunst, A. E., F. Groenhof and J. P. Mackenbach. 1998c. "Mortality by occupational class among men 30-64 years in 11 European countries. EU Working Group on Socioeconomic Inequalities in Health." *Soc Sci Med* 46:1459-76.

Kunst, A. E., F. Groenhof, J. P. Mackenbach and E. W. Health. 1998d. "Occupational class and cause specific mortality in middle aged men in 11 European countries: comparison of population based studies. EU Working Group on Socioeconomic Inequalities in Health." *Bmj* 316:1636-42.

Kunst, A. E., C. W. Looman and J. P. Mackenbach. 1990. "Socio-economic mortality differences in The Netherlands in 1950-1984: a regional study of cause-specific mortality." *Soc Sci Med* 31:141-52.

Kunst, A. E. and J. P. Mackenbach. 1994a. "International variation in the size of mortality differences associated with occupational status." *Int J Epidemiol* 23:742-50.

Kunst, A. E. and J. P. Mackenbach. 1994b. "The size of mortality differences associated with educational level in nine industrialized countries." *Am J Public Health* 84:932-7.

Kunst, Anton E and A. E. Cavelaars. 1996. "Working Document 4 from the concerted Action "Socioeconomic inequalities in morbidity and mortality in Europe: a comparative study. The measurement of occuaptional classes as defined in the Erikson-Goldthorpe scheme: comparison of two conversion aglogrithms." Pp. 241-258 in *Socioeconomic Inequalities in Morbidity and Mortality in Europe: a comparative study. Volume 2 Working Documents*, edited by A. E. Kunst, A. E. Cavelaars, F. Groenhof, J. J. Geurts and J. P. Mackenbach. Rotterdam: Department Public Health, Erasmus University.

Kunst, Anton E, A. E. Cavelaars, F. Groenhof, J. J. Geurts and J. P. Mackenbach. 1996a. "Socioeconmic Inequalities in Morbidity and Mortality in Europe: a comparative study. Volume 1: Main report." Rotterdam: Department of Public Health, Erasmus University.

Kunst, Anton E, A. E. Cavelaars, F. Groenhof, J. J. Geurts and J. P. Mackenbach. 1996b. "Socioeconomic Inequalities in Morbidity and Mortality in Europe: a comparative study. Volume 2 Working Documents." Rotterdam: Department Public Health, Erasmus University.

Kunst, Anton E and F. Groenhof. 1996. "Working Document 6 from the concerted Action "Socioeconomic inequalities in morbidity and mortality in Europe: a comparative study. Health Selection and mortality excess of economically inactive men: evidence from 4 longitudinal studies." Pp. 87-98 in *Socioeconomic Inequalities in Morbidity and Mortality in Europe: a comparative study. Volume 2 Working Documents*, edited by A. E. Kunst, A. E. Cavelaars, F. Groenhof, J. J. Geurts and J. P. Mackenbach. Rotterdam: Department Public Health, Erasmus University.

Kunst, Anton E and Joahn P Mackenbach. 1995. "Measuring Socioeconomic Inequalities in Health." Copenhagen: World Health Organization Regional Office for Europe.

Lahelma, E. and T. Valkonen. 1990. "Health and social inequities in Finland and elsewhere." *Soc Sci Med* 31:257-65.

Lang, T. and P. Ducimetiere. 1995. "Premature cardiovascular mortality in France: divergent evolution between social categories from 1970 to 1990." *Int J Epidemiol* 24:331-9.

Langford, I. H. and G. Bentham. 1996. "Regional variations in mortality rates in England and Wales: an analysis using multi-level modelling." *Soc Sci Med* 42:897-908.

Lawlor, D A, S Ebrahim and G Davey Smith. 2001. "Sex matters: secular and geographical trends in sex differences in coronary heart disease mortality." *BMJ* 323:541-545.

Lawlor, D. A., G. D. Smith, D. A. Leon, J. A. Sterne and S. Ebrahim. 2002. "Secular trends in mortality by stroke subtype in the 20th century: a retrospective analysis." *Lancet* 360:1818-23.

Leaverton, P. E., M. Feinleib and T. Thom. 1984. "Coronary heart disease mortality rates in United States blacks, 1968-1978: interstate variation." *Am Heart J* 108:732-7.

Leclerc, A. 1989. "Differential mortality by cause of death: comparison between selected European countries." Pp. 91-108 in *Health Inequalities in European countries*, edited by A. J. Fox. Aldershot: Gower Publishing Company.

Leclerc, A, F. Lert and C. Fabian. 1990. "Differential mortality: some comparisons between England and Wales, Finland and France, based on inequality measures." *Int J Epidemiol* 19:1001-1010.

Leclerc, A, F. Lert and M. Goldberg. 1984. "Les Inegalities sociales devant la mort en Grande-Bretagne et en France." *Soc Sci Med* 19:479-487.

Leinsalu, M., D. Vagero and A. E. Kunst. 2003. "Estonia 1989-2000: enormous increase in mortality differences by education.[see comment]." *Int J Epidemiol* 32:1081-7.

Leon, D. A. 2000. "Common threads: underlying components of inequalities in mortality between and within countries." in *Poverty Inequality and Health an International perspective*, edited by D. A. Leon and G. Watt. London: Oxford University Press.

Leon, D. A., D. Vagero and P. O. Olausson. 1992. "Social class differences in infant mortality in Sweden: comparison with England and Wales." *Bmj* 305:687-91.

Leon, David A and Gill Watt. 2000. "Poverty Inequality and Health an International perspective." London: Oxford University Press.

Lerner, M. and R. N. Stutz. 1977. "Have we narrowed the gaps between the poor and the nonpoor? Part II. Narrowing the gaps, 1959-1961 to 1969-1971: mortality." *Medical Care.* 15:620-35.

Liao, Y. and R. S. Cooper. 1995. "Continued adverse trends in coronary heart disease mortality among blacks, 1980-91." *Public Health Rep* 110:572-9; discussion 570-2.

Liberatos, P., B. G. Link and J. L. Kelsey. 1988. "The measurement of social class in epidemiology." *Epidemiol Rev* 10:87-121.

Lilenfield, A. M. 1956. "Variations in mortality from heart disease." *Public Health Report, Washington* 71:545.

Link, B. G. and J. C. Phelan. 2002. "McKeown and the idea that social conditions are fundamental causes of disease." *Am J Public Health* 92:730-2.

Logan, W. P. 1954. "Social class variations in mortality." *Br J Prev Soc Med* 8:128.

Lostao, L., E. Regidor, P. Aiach and V. Dominguez. 2001. "Social inequalities in ischaemic heart and cerebrovascular disease mortality in men: Spain and France, 1980-1982 and 1988-1990." *Soc Sci Med* 52:1879-87.

Lynch, J. and G. Kaplan. 2000. "Socioeconomic position." in *Social Epidemiology*, edited by L. F. Berkman and I. Kawachi. New York: Oxford University Press.

Lynch, J. W., G. A. Kaplan, R. D. Cohen, J. Tuomilehto and J. T. Salonen. 1996. "Do cardiovascular risk factors explain the relation between socioeconomic status, risk of all-cause mortality, cardiovascular mortality, and acute myocardial infarction?" *Am. J. Epidemiol.* 144:934-42.

Lynch, J. W., G. A. Kaplan and J. T. Salonen. 1997. "Why do poor people behave poorly? Variation in adult health behaviours and psychosocial characteristics by stages of the socioeconomic lifecourse." *Soc Sci Med* 44:809-19.

Lynch, J. W., G. D. Smith, G. A. Kaplan and J. S. House. 2000. "Income inequality and mortality: importance to health of individual income, psychosocial environment, or material conditions." *Bmj* 320:1200-4.

Maani, S. 1997. " Investing in Minds: The economics of higher education in New Zealand." Wellington.: Institute of Policy Studies.

Macintyre, S. 1997. "The Black Report and beyond: what are the issues?" *Soc Sci Med* 44:723-45.

Macintyre, S. and A. Ellaway. 2000. "Ecological Approaches: Rediscovering the Role of the Physical and Social Environment." in *Social Epidemiology*, edited by L. F. Berkman and I. Kawachi. New York: Oxford University Press.

Macintyre, S., A. Ellaway and S. Cummins. 2002. "Place effects on health: how can we conceptualise, operationalise and measure them?" *Soc Sci Med* 55:125-39.

Macintyre, S., A. Ellaway, R. Hiscock, A. Kearns, G. Der and L. McKay. 2003. "What features of the home and the area might help to explain observed relationships between housing tenure and health? Evidence from the west of Scotland." *Health & Place.* 9:207-18.

MacIntyre, Sally. 2001. "Inequalities in health:is research gender blind?" Pp. 283-293 in *Poverty, inequality and health An International Perspective*, edited by D. A. Leon and G. Walt. London, UK: Oxford University Press.

Mackenbach, J. and M. Bakker. 2002. "Reducing Inequalities in Health: A European Perspecitive." London: Routledge.

Mackenbach, J., M. Bakker, A. E. Kunst and F. Diderichsen. 2002. "Socioeconomic Inequalities in health in Europe." in *Reducing Inequalities in Health: A European Perspective*, edited by J. Mackenbach and M. Bakker. London: Routledge.

Mackenbach, J. P., V. Bos, O. Andersen, M. Cardano, G. Costa, S. Harding, A. Reid, O. Hemstrom, T. Valkonen and A. E. Kunst. 2003. "Widening socioeconomic inequalities in mortality in six Western European countries.[see comment]." *Int J Epidemiol* 32:830-7.

Mackenbach, J. P., A. E. Cavelaars, A. E. Kunst and F. Groenhof. 2000. "Socioeconomic inequalities in cardiovascular disease mortality; an international study." *Eur Heart J* 21:1141-51.

Mackenbach, J. P., M. Huisman, O. Andersen, M. Bopp, J. K. Borgan, C. Borrell, G. Costa, P. Deboosere, A. Donkin, S. Gadeyne, C. Minder, E. Regidor, T. Spadea, T. Valkonen and A. E. Kunst. 2004. "Inequalities in lung cancer mortality by the educational level in 10 European populations." *Eur J Cancer.* 40:126-35.

Mackenbach, J. P. and A. E. Kunst. 1997. "Measuring the magnitude of socio-economic inequalities in health: an overview of available measures illustrated with two examples from Europe." *Soc Sci Med* 44:757-71.

Mackenbach, J. P., A. E. Kunst, A. E. Cavelaars, F. Groenhof and J. J. Geurts. 1997. "Socioeconomic inequalities in morbidity and mortality in western Europe. The EU Working Group on Socioeconomic Inequalities in Health." *Lancet* 349:1655-9.

Mackenbach, J. P., A. E. Kunst, F. Groenhof, J. K. Borgan, G. Costa, F. Faggiano, P. Jozan, M. Leinsalu, P. Martikainen, J. Rychtarikova and T. Valkonen. 1999. "Socioeconomic inequalities in mortality among women and among men: an international study." *Am J Public Health* 89:1800-6.

Mackenbach, J. P., H. van de Mheen and K. Stronks. 1994. "A prospective cohort study investigating the explanation of socio-economic inequalities in health in The Netherlands." *Soc Sci Med* 38:299-308.

Marang-van de Mheen, P. J., G. Davey Smith, C. L. Hart and L. J. Gunning-Schepers. 1998. "Socioeconomic differentials in mortality among men within Great Britain: time trends and contributory causes." *J Epidemiol Community Health* 52:214-8.

Marmot, M. G. 2003. "Understanding social inequalities in health." *Perspectives in Biology & Medicine.* 46:S9-23.

Marmot, M. G., A. M. Adelstein, N. Robinson and G. A. Rose. 1978. "Changing social-class distribution of heart disease." *Br Med J* 2:1109-12.

Marmot, M. G. and M. E. McDowall. 1986. "Mortality decline and widening social inequalities." *Lancet* 2:274-6.

Marmot, M. G., M. J. Shipley and G. Rose. 1984. "Inequalities in death--specific explanations of a general pattern?" *Lancet* 1:1003-6.

Marmot, M. and Richard G Wilkinson. 1999. "Social Determinants of Health." New York: Oxford University Press.

Marshall, S. W., I. Kawachi, N. Pearce and B. Borman. 1993. "Social class differences in mortality from diseases amenable to medical intervention in New Zealand." *Int J Epidemiol* 22:255-61.

Martikainen, P., P. Makela, S. Koskinen and T. Valkonen. 2001a. "Income differences in mortality: a register-based follow-up study of three million men and women." *Int J Epidemiol* 30:1397-405.

Martikainen, P. and T. Valkonen. 1999. "Bias related to the exclusion of the economically inactive in studies on social class differences in mortality." *Int J Epidemiol* 28:899-904.

Martikainen, P., T. Valkonen and T. Martelin. 2001b. "Change in male and female life expectancy by social class: decomposition by age and cause of death in Finland 1971-95." *J Epidemiol Community Health* 55:494-9.

Mathers, C. 1994. "Health Differentials Among Adult Australians Aged 25-64 years. Health Monitoring Series No. 4." Canberra: Australian Institute of Health and Welfare.

Mathers, C. 1996. "Health Differentials Among Young Australian Adults. Health Monitoring Series No 4." Canberra: Australian Institute of Health and Welfare.

McDonough, P., G. J. Duncan, D. Williams and J. House. 1997. "Income dynamics and adult mortality in the United States, 1972 through 1989." *Am J Public Health* 87:1476-83.

McEwen, Bruce S. 1998. "Protective and Damaging Effects of Stress Mediators." *N Engl J Med* 338:171-179.

McLoone, P. and F. A. Boddy. 1994. "Deprivation and mortality in Scotland, 1981 and 1991." *Bmj* 309:1465-70.

McMichael, A. J. 1985. "Social class (as estimated by occupational prestige) and mortality in Australian males in the 1970s." *Community Health Stud* 9:220-30.

McMichael, A. J. 1999. "Prisoners of the proximate: loosening the constraints on epidemiology in an age of change." *Am J Epidemiol* 149:887-97.

McMichael, A. J., M. McKee, V. Shkolnikov and T. Valkonen. 2004. "Mortality trends and setbacks: global convergence or divergence?" *Lancet.* 363:1155-9.

McPherson, K M, M Harwood and H K McNaughton. 2003. "Ethnicity, equity, and quality: lessons from New Zealand." *BMJ* 327:443-444.

Miller, H.P. 1966. "Income Distribution in the United States." Pp. 216-217. Washington: US Bureau of Statistics.

Minder, C. 1991. "A conceptual and methodological discussionof transnational comparisons of socioeconomic mortality differences, and an example." Pp. 278-294 in *Proceedings of the 5th meeting of the UN/WHO/CICRED Network on socioeconomic differential mortality in industrialised countries*. Paris: CICRED.

Ministry of Health. 1997. "Strengthening Public Health Action. The strategic direction to improve, promote and protect public health." Wellington: Public Health Group Ministry of Health.

Ministry of Health. 1999. "Taking the Pulse The 1996/97 New Zealand Health Survey." Wellington: Ministry of Health.

Ministry of Health. 2000. "The New Zealand Health Strategy." Wellington: Ministry of Health, Manatu Hauora.

Ministry of Health. 2002. "Reducing Inequalities in Health." Wellington: Ministry of Health, Manatu Hauora.

Ministry of Social Development. 2001. "The Social Report 2001." Wellington: Ministry of Social Development.

Ministry of Social Development. 2002. "The Social Report 2002." Wellington: Ministry of Social Development.

Ministry of Social Development. 2003. "The Social Report 2003." Wellington: Ministry of Social Development.

Ministry of Social Development. 2004. "The Social Report: Indicators of social well-being in New Zealand (also available at http://www.socialreport.msd.govt.nz/)." Wellington: Ministry of Social Development.

Morgenstern, H. 1980. "The changing association between social status and coronary heart disease in a rural population." *Soc Sci Med [Med Psychol Med Sociol]* 14A:191-201.

Mowbray, Mary. 2001. "Distributions and Disparity New Zealand Household Incomes." Wellington: Information and Analysis Group, The Ministry of Social Policy.

Muntaner, C. 2004. "Commentary: Social capital, social class and the slow progress of psychosocial epidemiology." *Int J Epidemiol* 33:674-680.

Murray, C. J. and A. D. Lopez. 1997. "Mortality by cause for eight regions of the world: Global Burden of Disease Study." *Lancet* 349:1269-76.

National Institutes of Health. 1995. "Report of the conference of socioeconomic status and Cardiovascular health and disease November 6-7 1995." Washington D.C.: National Institute of Health: National Heart, Lung and Blood Institute.

Navarro, V. 2004. "Commentary: is capital the solution or the problem?" *Int J Epidemiol* 33:672-674.

Nazroo, J. Y. 2003. "The structuring of ethnic inequalities in health: economic position, racial discrimination, and racism." *Am J Public Health* 93:277-84.

O'Donoghue, B., P. Howden-Chapman and A. Woodward. 2000. "Why do Australians live longer than New Zealanders?" *Health Education & Behavior* 27:307-16.

OECD. 1990. *Education in OECD countries 1987-88. A compendum of statistical information. 1990 Special Edition*. Paris: OECD.

O'Neill, M. S., M. Jerrett, I. Kawachi, J. I. Levy, A. J. Cohen, N. Gouveia, P. Wilkinson, T. Fletcher, L. Cifuentes, J. Schwartz, Pollution Workshop on Air and Conditions Socioeconomic. 2003. "Health, wealth, and air pollution: advancing theory and methods." *Environmental Health Perspectives.* 111:1861-70.

Pamuk, E. 1985. "Social Class Inequality in Mortality from 1921 to 1972 in England and Wales." *Population Studies* 39:17-31.

Pamuk, E. 1988. "Social Class inequality in infant mortality in England and Wales from 1921 to 1980." *Eur J Population* 4:1-21.

Pappas, G., S. Queen, W. Hadden and G. Fisher. 1993. "The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986." *N Engl J Med* 329:103-9.

Parker, Robert Nash and Rudy Fenwick. 1983. "The Pareto Curve and Its Utility for Open-Ended Income Distributions in Survey Research." *Social Forces* 61:872-875.

Patno, M. E. 1960. "Mortality and economic level in an urban area." *Public Health Report, Washington* 75:841.

Pearce, N. and P. Bethwaite. 1997. "Social class and male cancer mortality in New Zealand, 1984-7." *N Z Med J* 110:200-2.

Pearce, N., P. Davis and A. Sporle. 2002. "Persistent social class mortality differences in New Zealand men aged 15-64: an analysis of mortality during 1995-97." *Aust N Z J Public Health* 26:17-22.

Pearce, N. E., P. B. Davis, A. H. Smith and F. H. Foster. 1983a. "Mortality and social class in New Zealand II: male mortality by major disease groupings." *N Z Med J* 96:711-6.

Pearce, N. E., P. B. Davis, A. H. Smith and F. H. Foster. 1983b. "Mortality and social class in New Zealand. I: overall male mortality." *N Z Med J* 96:281-5.

Pearce, N. E., P. B. Davis, A. H. Smith and F. H. Foster. 1984. "Mortality and social class in New Zealand. III: male mortality by ethnic group." *N Z Med J* 97:31-5.

Pearce, N. E., P. B. Davis, A. H. Smith and F. H. Foster. 1985. "Social class, ethnic group, and male mortality in New Zealand, 1974-8." *J Epidemiol Community Health* 39:9-14.

Pearce, N. E. and J. K. Howard. 1985. "Occupational mortality in New Zealand males 1974-78." *Community Health Stud* 9:212-9.

Pearce, N. E. and J. K. Howard. 1986. "Occupation, social class and male cancer mortality in New Zealand, 1974-78." *Int J Epidemiol* 15:456-62.

Pearce, N., S. Marshall and B. Borman. 1991. "Undiminished social class mortality differences in New Zealand men." *N Z Med J* 104:153-6.

Pearce, N., E. Pomare, S. Marshall and B. Borman. 1993. "Mortality and social class in Maori and nonMaori New Zealand men: changes between 1975-7 and 1985-7." *N Z Med J* 106:193-6.

Power, C. and C. Hertzman. 1997. "Social and biological pathways linking early life and adult disease." *Br Med Bull* 53:210-21.

Power, C., S. Matthews and O. Manor. 1996. "Inequalities in self rated health in the 1958 birth cohort: lifetime social circumstances or social mobility?" *Bmj* 313:449-53.

Preston, S. H. and I. T. Elo. 1995. "Are educational differentials in adult mortality increasing in the United States?" *J Aging Health* 7:476-96.

Public Health Advisory Committee. 2004. "The Health of People and Communities. A way forward: public policy and the economic determinants of health." Wellington: The Public Health Advisory Committee.

Public Health Commission. 1994. "A Strategic Direction to Improve and Protect the Public Health: The Public

Health CommissionÕs advice to the Minister of Health 1993-1994." Wellington: Public Health Commission.

Quine, S., R. Taylor and L. Hayes. 1995. "Australian trends in mortality by socioeconomic status using NSW small area data, 1970-89." *Journal of Biosocial Science* 27:409-19.

Rahkonen, O., S. Arber and E. Lahelma. 1997. "Health-related social mobility: a comparison of currently employed men and women in Britain and Finland." *Scand J Soc Med* 25:83-92.

Regidor, E., J. L. Gutierrez-Fisac and C. Rodriguez. 1995. "Increased socioeconomic differences in mortality in eight Spanish provinces." *Soc Sci Med* 41:801-7.

Regidor, E., P. Navarro, V. Dominguez and C. Rodriguez. 1997. "Inequalities in income and long-term disability in Spain: analysis of recent hypotheses using cross sectional study based on individual data." *Bmj* 315:1130-5.

Rogot, E. and Z. Hrubec. 1989. "Trends in mortality from coronary heart disease and stroke among U.S. veterans; 1954-1979." *J Clin Epidemiol* 42:245-56.

Rosamond, W. D., L. E. Chambless, A. R. Folsom, L. S. Cooper, D. E. Conwill, L. Clegg, C. H. Wang and G. Heiss. 1998. "Trends in the incidence of myocardial infarction and in mortality due to coronary heart disease, 1987 to 1994." *N Engl J Med* 339:861-7.

Rose, G. and M. G. Marmot. 1981. "Social class and coronary heart disease." *British Heart Journal.* 45:13-9.

Rothman, Kenneth J and Sander Greenland. 1998. "Modern Epidemiology." Philadelphia: Lippincott-Raven.

Salmond, C., P. Crampton and F. Sutton. 1998. "NZDep91: A New Zealand index of deprivation." *Aust N Z J Public Health* 22:835-7.

Schalick, L. M., W. C. Hadden, E. Pamuk, V. Navarro and G. Pappas. 2000. "The widening gap in death rates among income groups in the United States from 1967 to 1986." *Int J Health Serv* 30:13-26.

Sempos, C., R. Cooper, M. G. Kovar and M. McMillen. 1988. "Divergence of the recent trends in coronary mortality for the four major race-sex groups in the United States." *Am J Public Health* 78:1422-7.

Sharma, S., A. M. Malarcher, W. H. Giles and G. Myers. 2004. "Racial, ethnic and socioeconomic disparities in the clustering of cardiovascular disease risk factors." *Ethnicity & Disease* 14:43-8.

Shaw, M., D. Dorling, D. Gordon and G Davey Smith. 1999. "The widening gap. Health inequalities and policy in Britain." Bristol: The Policy Press.

Sheps, C. and J.H. Watkins. 1947. "Mortality in the Socio-Economic Districts of New Haven." *Yale J. Biol. Med.* 1:249 (cited in Antonovsky, 1968).

Shouls, S., P. Congdon and S. Curtis. 1996. "Modelling inequality in reported long term illness in the UK: combining individual and area characteristics." *Journal of Epidemiology & Community Health.* 50:366-76.

Silva, Isobel dos Santos. 1999. *Cancer Epidemiology: prinicples and methods*. Lyon, France: International Agency for Research on Cancer World Health Organisation.

Singh, G. K. 2003. "Area deprivation and widening inequalities in US mortality, 1969-1998." *Am J Public Health* 93:1137-43.

Singh, G. K., B. A. Miller and B. F. Hankey. 2002. "Changing area socioeconomic patterns in U.S. cancer mortality, 1950-1998: Part II--Lung and colorectal cancers." *J Natl Cancer Inst* 94:916-25.

Singh, Gopal K and Mohammad Siahpush. 2002. "Increasing inequalities in all-cause and cardiovascular mortality among US adults aged 25-64 years by area socioeconomic status, 1969-1998." *Int. J. Epidemiol.* 31:600-613.

Siskind, V., R. Copeman and J. M. Najman. 1987. "Socioeconomic status and mortality: a Brisbane area analysis." *Community Health Studies* 11:15-23.

Siskind, V., J. M. Najman and C. Veitch. 1992. "Socioeconomic status and mortality revisited: an extension of the Brisbane area analysis." *Australian Journal of Public Health* 16:315-20.

Sorlie, P. D., E. Backlund and J. B. Keller. 1995. "US mortality by economic, demographic, and social characteristics: the National Longitudinal Mortality Study." *Am J Public Health* 85:949-56.

Sporle, A., N. Pearce and P. Davis. 2002. "Social class mortality differences in Maori and non-Maori men aged 15-64 during the last two decades." *N Z Med J* 115:127-31.

Stamler, J., M. Kjelsberg and Y. Hall. 1960. "Epidemiologic studies of cardiovascular-renal diseases I: Analysis of mortality by age-race-sex-occupation." *Journal of Chronic Diseases.* 12:440.

Statistics New Zealand. 1984. *New Zealand Census of Population and Dwellings 1981 Vol 10 - Households and Families*. Wellington: Department of Statistics.

Statistics New Zealand. 1995. "New Zealand Standard Classification of Households and Families,." Wellington: Statistics New Zealand.

Statistics New Zealand. 1997. "Education (Census 96) (1996) - Reference Reports."

Statistics New Zealand. 1998a. "New Zealand Now: Families and Households." Wellington: Statistics New Zealand.

Statistics New Zealand. 1998b. "New Zealand Now: Young New Zealanders." Wellington: Statistics New Zealand.

Statistics New Zealand. 1999a. *New Zealand Now. Children*. Wellington: Statistics New Zealand.

Statistics New Zealand. 1999b. "New Zealand Now: Incomes." Wellington: Statistics New Zealand.

Subramanian, S. V. and Ichiro Kawachi. 2004. "Income Inequality and Health: What Have We Learned So Far?" *Epidemiol Rev* 26:78-91.

Susser, M. 1998. "Does risk factor epidemiology put epidemiology at risk? Peering into the future." *J Epidemiol Community Health* 52:608-611.

Susser, M., W Watson and K Hopper. 1985. "Sociology in Medicine." New York, NY: Oxford University Press.

Syme, S. L. and L. F. Berkman. 1976. "Social class, susceptibility and sickness." *Am J Epidemiol* 104:1-8.

Szreter, Simon and Michael Woolcock. 2004. "Health by association? Social capital, social theory, and the political economy of public health." *Int. J. Epidemiol.* 33:650-667.

Thom, T. J., F. H. Epstein, J. J. Feldman and P. E. Leaverton. 1985. "Trends in total mortality and mortality from heart disease in 26 countries from 1950 to 1978." *Int J Epidemiol* 14:510-20.

Thomson, Hilary, Mark Petticrew and David Morrison. 2001. "Health effects of housing improvement: systematic review of intervention studies." *BMJ* 323:187-190.

Tobias, M. and J. Cheung. 2001a. "Inhaling Inequality Tobacco's contribution to health inequality in New Zealand." Wellington: Ministry of Health.

Tobias, M. and J. Cheung. 2001b. "Life Expectancy and Small Area Deprivation in New Zealand." Wellington: Ministry of Health.

Tobias, M. and G. Jackson. 2001. "Avoidable mortality in New Zealand, 1981-97." *Aust N Z J Public Health* 25:12-20.

Townsend, Peter, Nick Davidson and M. Whitehead. 1988. "Inequalities in Health The Black Report and the Health Divide." Middlesex: Penguin.

Tunstall-Pedoe, H., K. Kuulasmaa, M. Mahonen, H. Tolonen, E. Ruokokoski and P. Amouyel. 1999. "Contribution of trends in survival and coronary-event rates to changes in coronary heart disease mortality: 10-year results from 37 WHO MONICA project populations. Monitoring trends and determinants in cardiovascular disease." *Lancet* 353:1547-57.

Tunstall-Pedoe, H., D. Vanuzzo, M. Hobbs, M. Mahonen, Z. Cepaitis, K. Kuulasmaa and U. Keil. 2000. "Estimation of contribution of changes in coronary care to improving survival, event rates, and coronary heart disease mortality across the WHO MONICA Project populations." *Lancet* 355:688-700.

Turrell, G, T.A. Blakely, C Patterson and B Oldenburg. 2004. "A multilevel analysis of socioeconomic (small area) differences in household food purchasing behaviour." *J Epidemiol Community Health* 58:208-215.

Turrell, G. and C. Mathers. 2001. "Socioeconomic inequalities in all-cause and specific-cause mortality in Australia: 1985-1987 and 1995-1997." *Int J Epidemiol* 30:231-9.

Turrell, G., B . Oldenburg, I. McGuffoy and R. Dent. 1999. "Socioeconomic Determinants of Health: towards a national research programme and a policy intervention agenda." Brisbane: Queensland University of Technology Center for Public Health Research.

Tyroler, H. A. 1999. "The influence of socioeconomic factors on cardiovascular disease risk factor development." *Prev Med* 29:S36-40.

Tyroler, H. A., G. Heiss, S. Heyden and C. G. Hames. 1980. "Family follow-up study of serum cholesterol in Evans County, Georgia." *J Chronic Dis* 33:323-30.

Uemura, K. and Z. Pisa. 1988. "Trends in cardiovascular disease mortality in industrialized countries since 1950." *World Health Stat Q* 41:155-78.

Vagero, D. and O. Lundberg. 1989. "Health inequalities in Britain and Sweden." *Lancet* 2:35-6.

Vagero, D. and S. E. Norell. 1989. "Mortality and Social Class in Sweden - Exploring a New Epidemiological Tool." *Scand J Soc Med* 17:49-58.

Valkonen, T. 1987. "Social inequalities in the face of death." Pp. 201-261 in *in proceedings of the plenaries of the European Population Conference, 1987, Jyvaskyla, Finland*. Helsinki: Central Statistical Office of Finland.

Valkonen, T. 1989. "Adult mortality and level of education: a comparison of six countries." Pp. 142-160 in *Health inequalities in European Countries*, edited by A. J. Fox.

Valkonen, T. 1993. "Problems in the measurement and international comparisons of socio-economic differences in mortality." *Soc Sci Med* 36:409-18.

Valkonen, T., P. Martikainen, Jalovaara. M., S. Koskinen, T. Martelin and P. Makela. 2000. "Changes in socioeonomic inequalities in mortality during an economic boom and recession among middle aged men and women in Finland." *Eur J Public Health* 10:274-280.

van de Mheen, H., K. Stronks, C. T. Schrijvers and J. P. Mackenbach. 1999. "The influence of adult ill health on occupational class mobility and mobility out of and into employment in the The Netherlands." *Soc Sci Med* 49:509-18.

van Rossum, C. T., M. J. Shipley, H. van de Mheen, D. E. Grobbee and M. G. Marmot. 2000. "Employment grade differences in cause specific mortality. A 25 year follow up of civil servants from the first Whitehall study." *J Epidemiol Community Health* 54:178-84.

Vartiainen, E., J. Pekkanen, S. Koskinen, P. Jousilahti, V. Salomaa and P. Puska. 1998. "Do changes in cardiovascular risk factors explain the increasing socioeconomic difference in mortality from ischaemic heart disease in Finland?" *J Epidemiol Community Health* 52:416-9.

Victora, C. G., J. P. Vaughan, F. C. Barros, A. C. Silva and E. Tomasi. 2000. "Explaining trends in inequities: evidence from Brazilian child health studies." *Lancet* 356:1093-8.

Wagstaff, A., P. Paci and E. van Doorslaer. 1991. "On the measurement of inequalities in health." *Soc Sci Med* 33:545-57.

Wagstaff, A. and E. van Doorslaer. 2000. "Income inequality and health: what does the literature tell us?" *Annu Rev Public Health* 21:543-67.

Wagstaff, A. and N. Watanabe. 2003. "What difference does the choice of SES make in health inequality measurement?" *Health Econ* 12:885-90.

White, I. R., D. Blane, J. N. Morris and P. Mourouga. 1999. "Educational attainment, deprivation-affluence and self reported health in Britain: a cross sectional study." *J Epidemiol Community Health* 53:535-41.

Whitehead, M. and G. Dahlgren. 1991. "What can be done about inequalities in health?" *Lancet* 338:1059-63.

Whitehead, M., F. Diderichsen and B. Burstrom. 2000. "Researching the impact of public policy on inequalities in health." in *Understanding inequalities in health*, edited by H. Graham. London: Open University Press.

Whitney, J.S. 1934. *Death Rates by Occupation, Based on Data of the U.S. Census Bureau*. New York: National Tuberculosis Association (cited in Antonvosky, 1967).

WHO. 1991. "Updating the European HFA targets." Copenhagen: WHO Regional Office for Europe.

Williams, D. R. 1999. "Race, socioeconomic status, and health. The added effects of racism and discrimination." *Ann N Y Acad Sci* 896:173-88.

Wing, S. 1988. "Social inequalities in the decline of coronary mortality." *Am J Public Health* 78:1415-6.

Wing, S., E. Barnett, M. Casper and H. A. Tyroler. 1992. "Geographic and socioeconomic variation in the onset of decline of coronary heart disease mortality in white women." *Am J Public Health* 82:204-9.

Wing, S., M. Casper, W. B. Davis, A. Pellom, W. Riggan and H. A. Tyroler. 1988a. "Stroke mortality maps. United States whites aged 35-74 years, 1962-1982." *Stroke* 19:1507-13.

Wing, S., M. Casper, W. Davis, C. Hayes, W. Riggan and H. A. Tyroler. 1990. "Trends in the geographic inequality of cardiovascular disease mortality in the United States, 1962-1982." *Soc Sci Med* 30:261-6.

Wing, S., M. Casper, W. Riggan, C. Hayes and H. A. Tyroler. 1988b. "Socioenvironmental characteristics associated with the onset of decline of ischemic heart disease mortality in the United States." *Am J Public Health* 78:923-6.

Wing, S., P. Dargent-Molina, M. Casper, W. Riggan, C. G. Hayes and H. A. Tyroler. 1987. "Changing association between community occupational structure and ischaemic heart disease mortality in the United States." *Lancet* 2:1067-70.

Wing, S., C. Hayes, G. Heiss, E. John, M. Knowles, W. Riggan and H. A. Tyroler. 1986. "Geographic variation in the onset of decline of ischemic heart disease mortality in the United States." *Am J Public Health* 76:1404-8.

Woodward, A, C. Mathers and M. Tobias. 2001. "Migrants, money and margarine. Possible explanations for Australia - New Zealand mortality differences." Pp. 114-128 in *The*

Social Origins of Health and Well-being, edited by R. Eckersley, J. Dixon and R. Douglas. Cambridge: Cambridge University Press.

Yeracaris, C. A. and J. H. Kim. 1978. "Socioeconomic differentials in selected causes of death." *Am J Public Health* 68:342-51.