



Decades of disparity: widening ethnic mortality gaps from 1980 to 1999

Tony Blakely, Shilpi Ajwani, Bridget Robson, Martin Tobias, Martin Bonné

Abstract

Background Maori and Pacific deaths were severely undercounted in the mid-1980s and first half of 1990s, resulting in numerator-denominator bias when calculating mortality rates by ethnicity. We used the New Zealand Census-Mortality Study to adjust for this bias and calculate corrected ethnic-specific mortality rates from 1980 to 1999.

Methods Age-specific adjusters were calculated for the period 1980–99. They were applied to mortality data to obtain a corrected number of deaths. Mortality rates (by age and gender) were calculated by dividing the total number of adjusted deaths by the respective census counts.

Results Contrary to unadjusted rates, corrected Maori and Pacific mortality rates were clearly higher than non-Maori non-Pacific rates during the 1980s and early 1990s. From 1980–84 (1361 per 100,000 for males and 965 per 100,000 for females) to 1996–99 (1258 and 894), there was only a modest decrease in Maori 1 to 74 year old mortality rates. Pacific mortality rates changed little from 1980–84 (1264 and 672) to 1996–99 (1144 and 696 per 100,000 for males and females respectively). Non-Maori non-Pacific mortality rates, however, decreased by about 30% from 1980–84 (919 and 553) to 1996–99 (641 and 407 per 100,000 for males and females, respectively).

Cancer (lung, prostate, breast, colorectal) mortality rates tended to increase over time among Maori compared to steadily decreasing among non-Maori non-Pacific. Of note, Pacific colorectal cancer mortality rates have increased by about ten-fold during the 1980s and 1990s. All ethnic groups experienced falls in cardiovascular disease mortality rates, but the decreases were much greater among non-Maori non-Pacific.

Conclusion The gaps between Maori and non-Maori non-Pacific mortality widened over the 1980s and 1990s mainly due to steadily declining non-Maori non-Pacific mortality rates and stagnant Maori mortality rates. Likewise, the gaps between Pacific and non-Maori non-Pacific mortality also widened during that period.

This paper presents Maori, Pacific, and non-Maori non-Pacific mortality rate trends during the 1980s and 1990s. The results presented in this paper, for the first time, correct for ‘undercounting of Maori and Pacific deaths’ and ‘modest overcounting of non-Maori non-Pacific deaths’ that occurred during that period. This so-called numerator-denominator bias for ethnicity recording between census and mortality data has been known about for some time.^{1–4} However, it is only with the recent record linkage of census and mortality data in the New Zealand Census-Mortality Study (NZCMS)^{5,6} that we can now accurately determine ethnic mortality trends.

The New Zealand Census Mortality Study (NZCMS) anonymously and probabilistically links census and mortality data. This linkage allowed a direct

comparison of the self-identified ethnicity of an individual at the previous census and the ethnicity on the death registration form. Consequently, it was possible to ‘unlock’ the numerator-denominator bias and calculate age-specific adjustment ratios (adjusters) to correct the discrepancy in the ‘numerator’.

The results in this paper are the culmination of a substantial body of work that has been published previously in this journal⁷⁻⁹ and in reports published elsewhere.¹⁰⁻¹²

Accurate ethnic mortality trend data is essential for the Government to monitor trends on population health outcomes. Socioeconomic and ethnic inequalities in mortality represent a category of health outcome of particular concern.¹³ It is of particular interest to monitor what happened to ethnic mortality trends during the 1980 to 1999 period, a period of major structural change in the New Zealand economy and society overall.

Methods

Mortality data—Mortality data was provided by the New Zealand Health Information Services (NZHIS) for the years 1980–1999 (by year of registration of death). Years were grouped into four periods: 1980–84, 1985–89, 1990–1995, and 1996–99. Note that the third period is of 6 years’ duration, and the fourth period of four years’ duration. This variation was due to a major change in the collection of mortality data ethnicity in late 1995. Up until then, only Maori or Pacific ethnicity was allowed on mortality data, and all remaining deaths (without the Maori or Pacific options identified) were assigned as non-Maori non-Pacific. During the late 1990s, the ethnicity question was changed to be consistent with the 1996 census, and was made compulsory.

Census data—For each of the four above periods, 1981, 1986, 1991, and 1996 census data (by strata of sex, age, and ethnicity) was used as denominator data in the calculation of mortality rates. This paper predominantly reports the prioritised ethnic series whereby ethnicity was assigned as Maori if one of the three possible self-identified ethnicity responses on the 1986 or the 1991 or the 1996 census was Maori.

Therefore, for Maori, the prioritised ethnic group represents the total Maori Ethnic Group (MEG). For those not allocated as Maori, the prioritised ethnic group was assigned as Pacific if one of the self-identified ethnic groups was Pacific. The remaining records were assigned as non-Maori non-Pacific. The 1981 census collected degree of ethnic origin. To form a prioritised series for the 1981 census, we assigned as Maori those who recorded any degree of Maori ethnic origin. Of the remainder, those who recorded any degree of Pacific ethnic origin were categorised as Pacific. Although the definition is not identical to the 1986 and 1991 censuses, it is similar enough to form a time series.

We also determined mortality rates for a sole series—although not the major focus of this paper. Here, census respondents were assigned as sole Maori or sole Pacific if only one ethnicity was identified.

Calculating adjustment ratios for numerator-denominator bias—The quantification of numerator-denominator bias, and consequent adjustment ratios, have been presented in detail elsewhere.^{9,11,12}

Briefly, we cross-classified census prioritised ethnicity counts by mortality data ethnicity counts (prioritised for 1996–99; the single [and only] option for three earlier periods) for decedents aged 1–74 years in each 3-year period after the censuses during the 1980s and 1990s. (The NZCMS is not well-suited for calculating ratios for infant deaths and deaths aged 75 years and older.)

From these cross-classifications, we calculated census to mortality ratios (adjusters) for Maori, Pacific, and non-Maori non-Pacific. There was marked variation in these ratios by age, with greater bias in younger age groups. Therefore, age-specific adjusters were used to recalculate mortality rates. A ratio greater than 1.0 for Maori, for example, corresponds to more Maori being on census data compared to mortality data (ie, mortality data undercounting Maori relative to census data).

Finally, we smoothed the observed ratios across 5-year age categories for analyses in this paper (see pages 59–61 and Table 2 of reference 12 for details on smoothing and actual ratios used).

Calculating age-standardised mortality rates—The observed number of deaths in each sex by age by ethnicity (by cause of death) strata (according to NZHIS data) was multiplied by the above adjustment ratios. These corrected mortality counts and the census (prioritised) counts were then used to calculate

direct age-standardised mortality rates (and 95% confidence intervals)¹⁴ using the WHO standard population.

Results

Figure 1 shows the age-standardised 1-74 year old mortality rates for the prioritised ethnic series—both unadjusted and adjusted for numerator-denominator. Without using adjustment ratios, Pacific mortality rates up to the mid-1990s appear to be lower than both Maori and non-Maori non-Pacific mortality, and there appears to be little difference between Maori and non-Maori non-Pacific mortality.

In the late 1990s, due to much-improved recording of ethnicity on mortality data, the unadjusted mortality rates jump markedly for Maori and Pacific. This unadjusted pattern is clearly spurious. Had we used sole census data for denominators in the first three periods, the unadjusted Maori and Pacific mortality rates would have been somewhat higher—but still underestimated.

Figure 1b and Figure 1d show the male and female corrected age-standardised mortality rates (actual rates are in Table 1). First, among non-Maori non-Pacific, there has been a 30% and 26% reduction in mortality rates over the 20-year period for males and females, respectively. In contrast, there was only a modest decrease in Maori mortality rates (8% for males and 7% for females), and no obvious change in Pacific mortality rates. Second, these divergent mortality trends by ethnicity meant that the gaps between Maori and non-Maori non-Pacific, and between Pacific and non-Maori non-Pacific, widened over the 1980s and 1990s.

The rate ratio comparing Maori to non-Maori non-Pacific increased from 1.48 in 1980–84 to 1.96 in 1996–99 for males, and from 1.74 to 2.20 for females. The rate ratio comparing Pacific to non-Maori non-Pacific increased from 1.38 in 1980–84 to 1.79 in 1996–99 for males and from 1.22 to 1.71 for females. Third, and not shown in Figure 1 and Table 1, Maori and Pacific mortality rates using a sole definition of ethnicity tended to be higher again. Additionally, whereas the prioritised series shown in Figure 1 may be consistent with a small decrease in Maori mortality rates from 1980–84 to 1996–99, the sole series demonstrated no change. (Full information on the sole series is presented elsewhere.¹²)

The above patterns of strong improvements in non-Maori non-Pacific mortality rates, and little (if any) improvement in Maori and Pacific mortality rates were similar across age groups—except, perhaps, among Pacific children (1–14 year olds) and youth (15–24 year olds), and Maori 25–44 year olds where reductions have occurred (Figure 2 and Table 1).

Nevertheless, the mortality gaps between Maori and non-Maori non-Pacific among 25–44, 45–64 and 65–74 year olds were large (especially the 45–64 year olds) and widening over time.

Table 1. Age-standardised all-cause mortality rates (per 100,000; 95% confidence intervals in parentheses) by ethnicity (prioritised series) by age group and sex

Age group	Ethnic group	1980-84	1985-89	1990-95	1996-99
<i>Males</i>					
1-14 years	Maori	49.0 (44.8-53.2)	48.9 (44.7-53.1)	41.8 (38.2-45.3)	43.7 (39.7-47.8)
	Pacific	70.6 (60.2-81.0)	50.2 (42.0-58.3)	46.9 (40.5-53.3)	31.3 (25.2-37.4)
	non-M non-P	35.4 (33.6-37.2)	33.1 (31.3-34.9)	25.6 (24.1-27.1)	20.6 (19.0-22.2)
15-24 years	Maori	148 (138-157)	159 (150-169)	154 (145-163)	142 (132-152)
	Pacific	125 (105-144)	148 (130-166)	95.5 (83.9-107)	112 (96.4-127)
	non-M non-P	103 (99.5-106)	106 (102-109)	95.5 (92.4-98.7)	72 (68.9-75.9)
25-44 years	Maori	284 (270-298)	277 (264-290)	262 (252-273)	253 (242-264)
	Pacific	199 (177-220)	212 (193-231)	180 (166-193)	213 (196-230)
	non-M non-P	129 (126-132)	123 (120-126)	113 (111-116)	95 (92.3-97.6)
45-64 years	Maori	1750 (1697-1803)	1734 (1685-1783)	1723 (1682-1764)	1569 (1527-1612)
	Pacific	1310 (1204-1415)	1325 (1241-1408)	1071 (1015-1127)	1173 (1109-1237)
	non-M non-P	787 (779-796)	707 (699-715)	606 (599-612)	502 (495-510)
65-74 years	Maori	5672 (5452-5891)	5318 (5111-5525)	5469 (5291-5647)	5296 (5118-5473)
	Pacific	4567 (4078-5057)	5075 (4653-5496)	4185 (3922-4448)	4421 (4148-4695)
	non-M non-P	3205 (3175-3235)	2949 (2921-2977)	2592 (2569-2615)	2122 (2098-2147)

Age group	Ethnic group	1980-84	1985-89	1990-95	1996-99
1-74 years	Maori	1361 (1323-1399)	1265 (1232-1298)	1296 (1266-1326)	1258 (1227-1289)
	Pacific	1264 (1143-1384)	1155 (1083-1227)	1122 (1065-1178)	1144 (1092-1196)
	non-M non-P	919 (912-925)	850 (844-855)	745 (740-749)	641 (636-646)
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<i>Females</i>					
1-14 years	Maori	55.4 (49.1-61.6)	61.8 (55.1-68.5)	50.5 (45.1-55.9)	50.6 (44.5-56.6)
	Pacific	66.7 (52.7-80.7)	55.2 (43.3-67.1)	56.7 (46.9-66.5)	32.8 (24.2-41.5)
	non-M non-P	41.9 (39.1-44.7)	37.7 (35.0-40.4)	29.7 (27.5-31.9)	22.8 (20.4-25.1)
15-24 years	Maori	202 (187-218)	227 (211-243)	238 (222-253)	200 (183-217)
	Pacific	169 (137-201)	209 (178-239)	135 (115-155)	166 (139-192)
	non-M non-P	145 (140-151)	156 (150-162)	139 (134-144)	102 (96.1-108)
25-44 years	Maori	340 (318-361)	356 (335-377)	328 (311-344)	337 (319-355)
	Pacific	254 (220-288)	271 (241-301)	236 (213-258)	246 (219-272)
	non-M non-P	163 (158-168)	158 (153-162)	149 (145-153)	127 (123-132)
45-64 years	Maori	2070 (1988-2152)	2012 (1936-2087)	1960 (1897-2023)	1875 (1809-1941)
	Pacific	1631 (1462-1799)	1644 (1512-1776)	1318 (1229-1408)	1464 (1362-1566)
	non-M non-P	1012 (998-1026)	891 (878-903)	737 (726-748)	607 (596-619)
65-74 years	Maori	6553 (6216-6890)	6282 (5951-6614)	6543 (6255-6830)	6146 (5865-6428)

Age group	Ethnic group	1980-84	1985-89	1990-95	1996-99
	Pacific	6291 (5431-7152)	6788 (6066-7510)	5595 (5135-6056)	5994 (5510-6478)
	non-M non-P	4266 (4214-4317)	3940 (3892-3988)	3448 (3408-3487)	2757 (2716-2798)
1-74 years	Maori	965 (935-995)	886 (860-911)	927 (905-950)	894 (871-917)
	Pacific	672 (613-731)	738 (690-786)	658 (624-691)	696 (662-729)
	non-M non-P	553 (549-557)	525 (521-528)	461 (458-464)	407 (404-410)

non-M: non-Maori; non-P: non-Pacific.

Table 2. Age-standardised mortality rates (per 100,000; 95% CIs in parentheses) by ethnicity (prioritised series) for causes of death and age-groups shown in Figure 3, Figure 4 and Figure 5

Age group	Ethnic group	1980-84	1985-89	1990-95	1996-99
<i>Males</i>					
Lung Ca	Maori	84.2 (76.0-92.3)	76.3 (68.6-83.9)	86.6 (79.6-93.6)	85.8 (78.7-92.9)
	Pacific	54.8 (38.0-71.5)	55.5 (42.5-68.5)	58.6 (48.6-68.6)	64.0 (53.1-74.8)
	non-M non-P	40.6 (39.4-41.9)	36.4 (35.3-37.6)	31.7 (30.7-32.6)	24.5 (23.6-25.5)
Prostate Ca	Maori	11.5 (8.3-14.7)	13.9 (10.5-17.4)	15.5 (12.4-18.7)	16.1 (12.8-19.3)
	Pacific	18.0 (7.4-28.6)	20.8 (11.7-29.8)	13.5 (8.2-18.7)	11.2 (6.5-15.9)
	non-M non-P	8.8 (8.2-9.3)	8.9 (8.4-9.5)	9.7 (9.2-10.2)	8.6 (8.0-9.1)
Colorectal Ca	Maori	12.9 (9.8-16.1)	13.7 (10.6-16.8)	14.2 (11.4-16.9)	18.9 (15.5-22.2)
	Pacific	1.7 (0.5-3.8)	11.1 (4.9-17.2)	8.1 (4.6-11.5)	17.9 (12.3-23.5)
	non-M non-P	21.4 (20.5-22.3)	21.0 (20.1-21.8)	21.7 (20.9-22.5)	19.6 (18.7-20.5)
IHD	Maori	257.5 (243-272)	228.2 (215-241)	241.1 (230-252)	218.1 (207-229)
	Pacific	188.7 (159-218)	199.4 (174-225)	158.5 (143-174)	166.4 (150-183)
	non-M non-P	175.4 (173-178)	149.2 (147-151)	112.3 (111-114)	79.9 (78.1-81.6)
Stroke	Maori	51.0 (44.6-57.3)	51.8 (45.5-58.2)	42.8 (38.1-47.6)	31.3 (27.1-35.6)
	Pacific	81.4 (61.4-101)	71.8 (56.5-87.1)	58.2 (48.3-68.1)	51.8 (42.0-61.7)
	non-M non-P	33.8 (32.7-34.9)	26.4 (25.4-27.3)	21.6 (20.8-22.3)	15.3 (14.5-16.0)
Respiratory	Maori	89.7 (81.4-97.9)	78.3 (70.6-85.9)	61.4 (55.6-67.3)	52.4 (46.7-58.1)
	Pacific	93.2 (70.8-116)	110.5 (91.4-130)	46.9 (37.7-56.1)	59.1 (48.4-69.7)
	non-M non-P	40.4 (39.2-41.6)	34.9 (33.8-35.9)	23.9 (23.1-24.7)	20.0 (19.1-20.8)

Age group	Ethnic group	1980-84		1985-89		1990-95		1996-99	
Unint. injury	Maori	91.6	(85.2-98.0)	89.1	(83.3-94.9)	78.4	(73.7-83.0)	68.6	(63.8-73.4)
	Pacific	69.8	(58.1-81.6)	57.0	(47.4-66.5)	43.0	(37.2-48.9)	39.3	(33.0-45.5)
	non-M non-P	49.4	(48.0-50.9)	48.8	(47.4-50.2)	39.8	(38.6-41.0)	29.6	(28.4-30.8)
Suicide 15-24	Maori	13.5	(9.4-17.6)	46.5	(39.1-53.8)	58.8	(51.2-66.5)	64.0	(54.5-73.4)
	Pacific	10.1	(2.2-18.1)	33.1	(21.0-45.3)	40.7	(29.7-51.7)	37.0	(24.4-49.6)
	non-M non-P	19.0	(16.9-21.1)	26.9	(24.4-29.4)	36.8	(34.0-39.5)	31.3	(28.1-34.5)
Suicide 25-44	Maori	16.3	(11.8-20.9)	18.2	(13.6-22.9)	29.3	(24.6-34.0)	54.6	(47.5-61.6)
	Pacific	16.7	(8.4-24.9)	19.9	(12.2-27.6)	18.5	(12.4-24.5)	25.9	(17.5-34.3)
	non-M non-P	20.9	(19.2-22.7)	23.7	(21.9-25.5)	28.0	(26.3-29.7)	32.2	(29.9-34.4)
<i>Females</i>									
Lung Ca	Maori	48.7	(42.6-54.8)	54.5	(48.4-60.5)	59.6	(54.4-64.9)	68.7	(62.7-74.7)
	Pacific	5.0	(1.3-8.7)	18.2	(11.2-25.2)	14.3	(9.9-18.8)	20.3	(14.8-25.8)
	non-M non-P	11.6	(10.9-12.2)	13.6	(12.9-14.3)	15.1	(14.5-15.8)	14.0	(13.2-14.7)
Breast Ca	Maori	31.0	(26.6-35.5)	30.6	(26.5-34.8)	29.7	(26.1-33.3)	35.7	(31.7-39.7)
	Pacific	14.6	(8.6-20.7)	36.2	(27.8-44.6)	26.5	(21.2-31.8)	42.8	(35.4-50.2)
	non-M non-P	24.4	(23.4-25.3)	24.8	(23.9-25.8)	23.8	(22.9-24.6)	21.3	(20.3-22.2)
Colorectal Ca	Maori	7.1	(4.8-9.3)	9.2	(6.7-11.6)	9.8	(7.7-11.9)	11.2	(8.8-13.6)
	Pacific	1.1	(0.3-2.6)	3.8	(0.6-6.9)	5.7	(3.0-8.4)	10.3	(6.5-14.0)
	non-M non-P	17.5	(16.7-18.3)	17.1	(16.3-17.8)	15.8	(15.1-16.4)	14.1	(13.4-14.8)
IHD	Maori	143.9	(133-155)	130.9	(121-140)	122.0	(114-130)	99.2	(92.0-107)
	Pacific	68.0	(51.5-84.6)	77.9	(62.8-93.0)	69.5	(59.5-79.4)	52.9	(44.0-61.8)

Age group	Ethnic group	1980-84		1985-89		1990-95		1996-99	
	non-M non-P	65.1	(63.7-66.5)	52.1	(50.8-53.3)	39.2	(38.2-40.2)	24.1	(23.2-25.0)
Stroke	Maori	62.5	(55.7-69.4)	49.0	(43.3-54.8)	45.9	(41.2-50.5)	33.9	(29.7-38.1)
	Pacific	71.0	(53.1-89.0)	49.9	(37.8-62.0)	46.5	(38.4-54.5)	41.2	(33.4-49.1)
	non-M non-P	27.1	(26.1-28.0)	20.4	(19.6-21.2)	16.4	(15.7-17.0)	11.9	(11.2-12.5)
Respiratory	Maori	73.4	(66.2-80.6)	69.7	(63.0-76.4)	63.0	(57.5-68.5)	56.6	(51.1-62.1)
	Pacific	47.4	(33.8-61.0)	51.5	(39.7-63.2)	25.0	(19.4-30.6)	20.8	(15.4-26.1)
	non-M non-P	19.8	(19.0-20.6)	20.7	(19.9-21.5)	15.6	(14.9-16.2)	13.8	(13.1-14.5)
Unint. injury	Maori	28.3	(24.8-31.7)	32.7	(29.2-36.3)	28.9	(26.0-31.9)	22.4	(19.8-24.9)
	Pacific	12.5	(7.2-17.7)	17.3	(12.8-21.8)	12.7	(9.7-15.7)	11.4	(8.1-14.7)
	non-M non-P	18.0	(17.1-18.9)	16.8	(16.0-17.6)	13.7	(13.0-14.4)	10.3	(9.6-11.1)
Suicide 15-24	Maori	4.9	(2.1-7.7)	14.1	(9.4-18.7)	16.8	(12.1-21.5)	26.5	(17.9-35.1)
	Pacific	12.4	(3.7-21.1)	3.3	(0.8-7.5)	5.9	(1.5-10.3)	7.9	(1.2-14.6)
	non-M non-P	4.8	(3.8-5.9)	6.6	(5.4-7.8)	6.9	(5.7-8.1)	12.1	(10.2-13.9)
Suicide 25-44	Maori	6.0	(3.0-8.9)	3.1	(1.2-4.9)	5.6	(3.4-7.9)	15.1	(10.3-19.9)
	Pacific	-	-	1.9	(0.5-4.3)	1.8	(0.4-3.9)	5.1	(1.2-9.0)
	non-M non-P	7.6	(6.5-8.6)	7.0	(6.1-8.0)	7.0	(6.2-7.9)	8.6	(7.5-9.7)

IHD: Ischaemic heart disease; Ca: Cancer; non-M: non-Maori; non-P: non-Pacific; Unintentional: Unintentional.

Figure 1. Age-standardised all-cause mortality rates (per 100,000) by ethnicity (prioritised series), by sex for 1-74 year olds, and unadjusted and adjusted for numerator-denominator bias

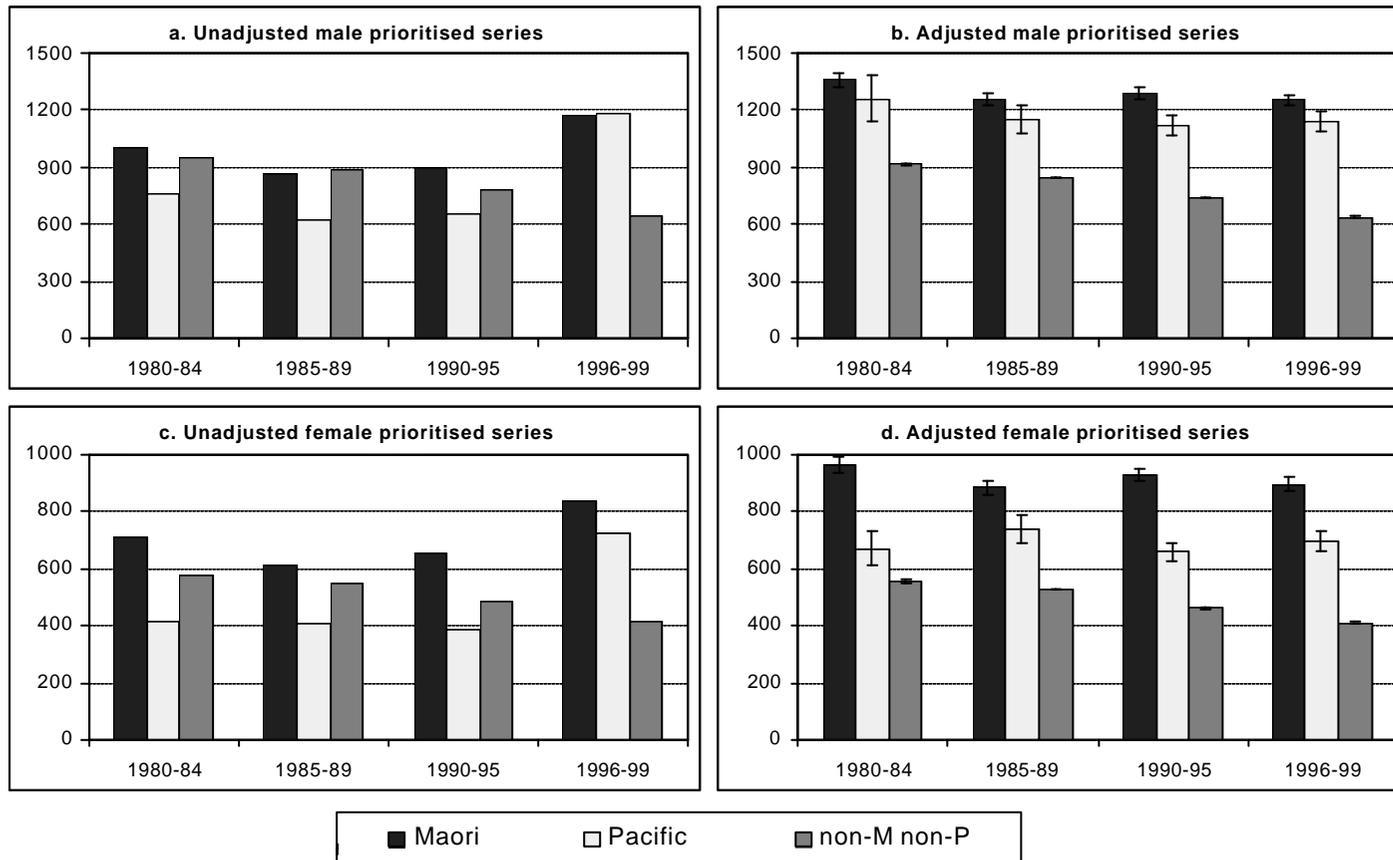


Figure 2. Age-standardised all-cause mortality rates (per 100,000) by ethnicity (prioritised series) by age for 1–74 year olds (sexes combined)

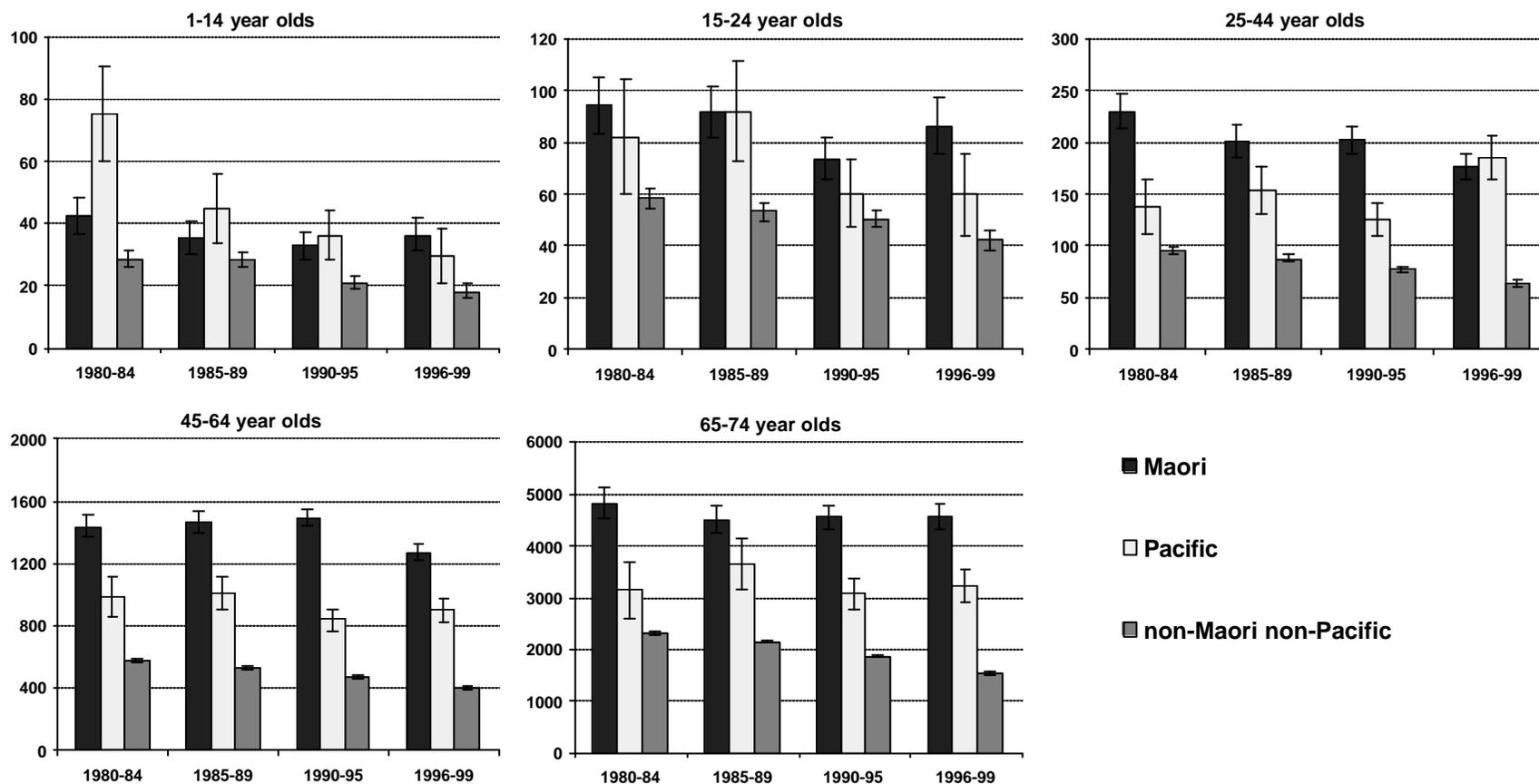
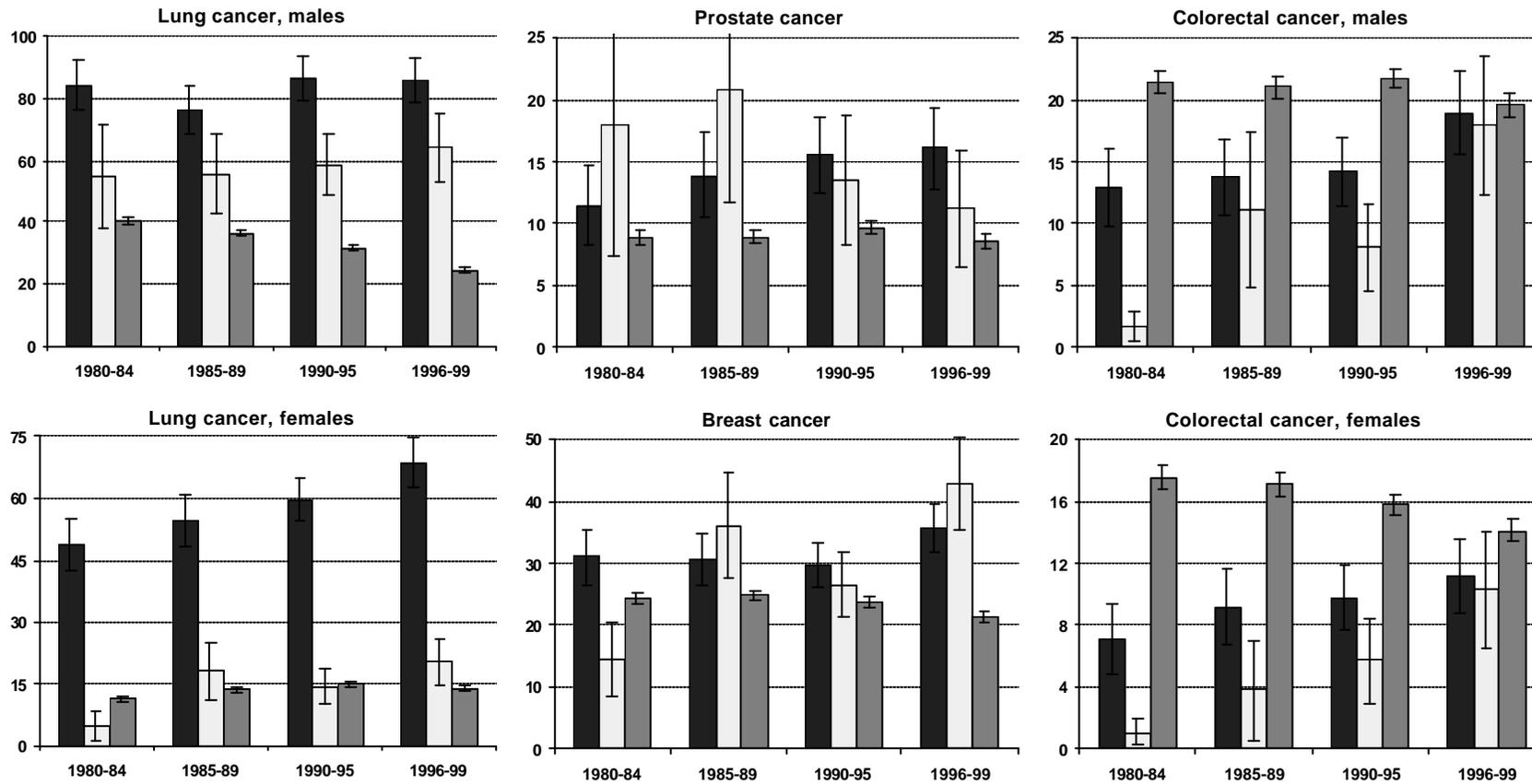
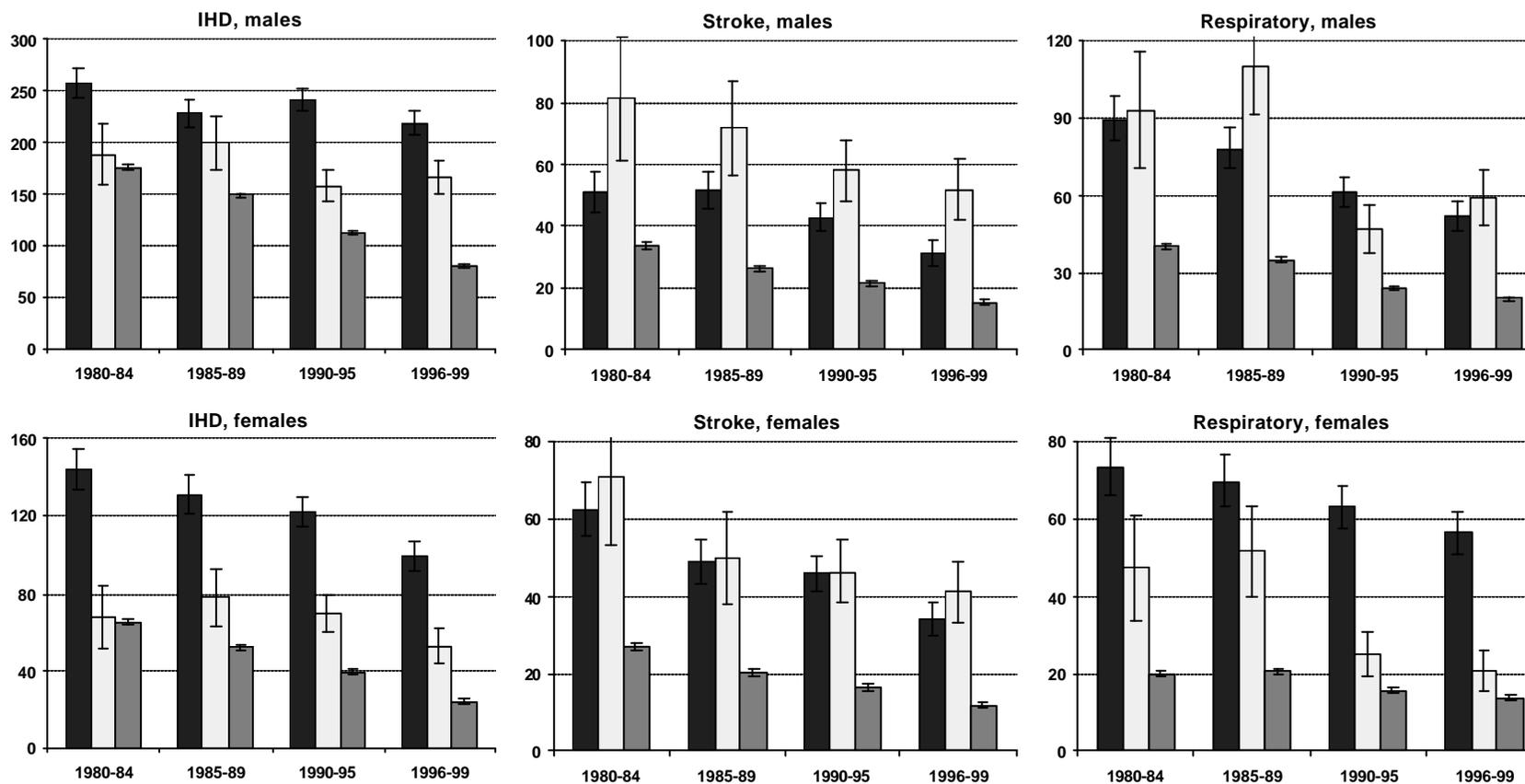


Figure 3: Age-standardised lung-, prostate-, breast-, and colorectal-cancer mortality rates (per 100,000) by ethnicity for 1–74 year olds



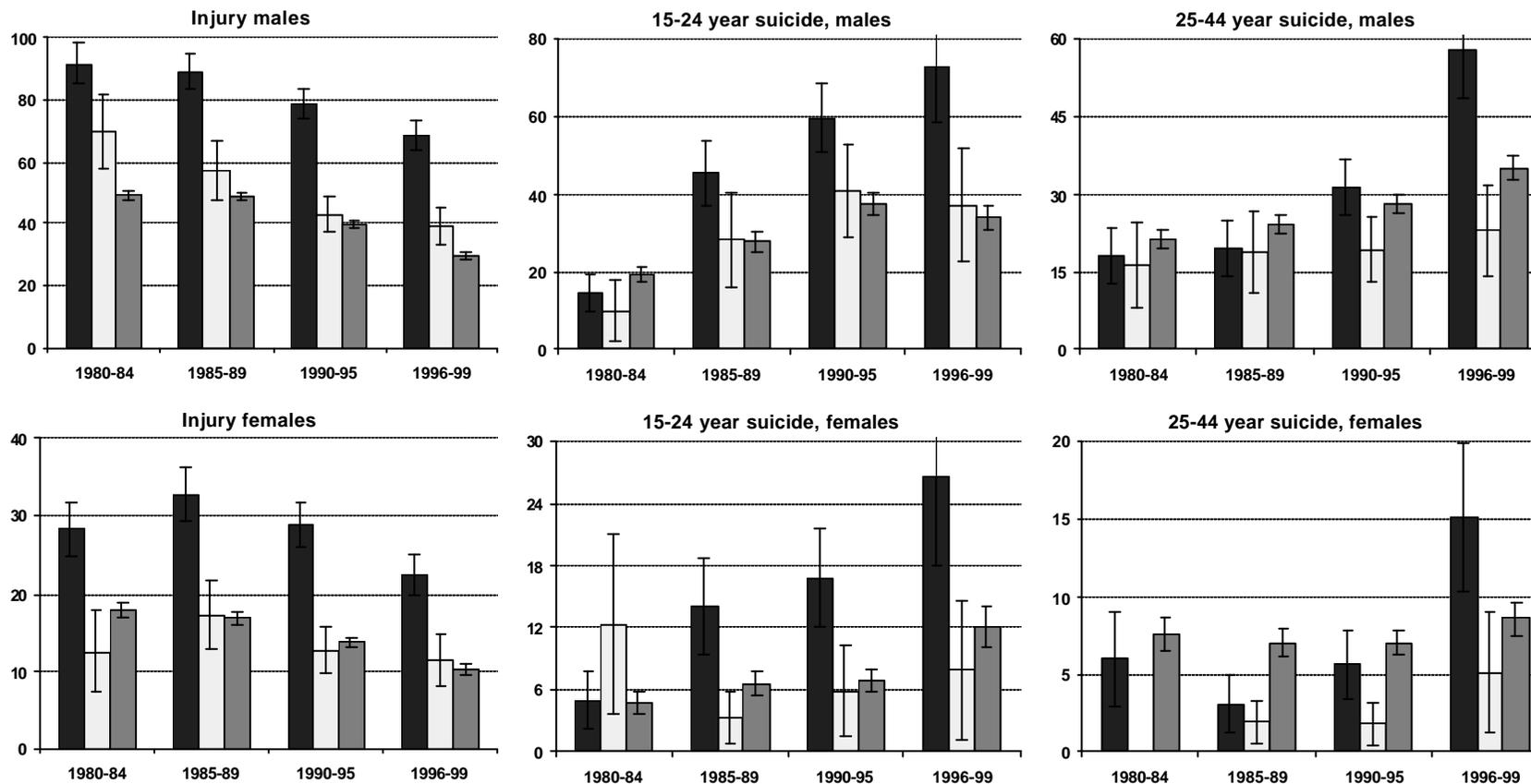
Column legend as in Figure 2: Maori first column (black background, white spots); Pacific second column (white background, black spots); non-Maori non-Pacific third column (white background, black diagonal stripes). Error bars are 95% confidence intervals.

Figure 4. Age-standardised ischaemic heart disease (IHD), stroke, and respiratory mortality rates (per 100,000) by ethnicity for 1–74 year olds



Column legend as in Figure 2: Maori first column (black background, white spots); Pacific second column (white background, black spots); non-Maori non-Pacific third column (white background, black diagonal stripes). Error bars are 95% confidence intervals.

Figure 5. Age-standardised 1-74 year olds unintentional injury and 15-24 and 25-44 year old suicide mortality rates (per 100,000) by ethnicity



Column legend as in Figure 2: Maori first column (black background, white spots); Pacific second column (white background, black spots); non-Maori non-Pacific third column (white background, black diagonal stripes). Error bars are 95% confidence intervals.

The mortality trends varied markedly by cause of death as shown in Figure 3, Figure 4, and Figure 5 for the prioritised series (data in Table 2). (Patterns were similar using the sole series.) There was a strong pattern of diverging Maori and non-Maori non-Pacific lung cancer mortality rates, such that (by 1996–99) the relative risks were 3.50 (males) and 4.91 (females). Pacific lung cancer rates were similar to those for non-Maori non-Pacific females, but intermediate for males. Prostate cancer mortality rates increased over time among Maori, while remaining essentially stable among non-Maori non-Pacific.

By 1996–99 non-Maori non-Pacific prostate cancer rates were half those of Maori. Pacific prostate cancer rates appeared to decrease over time. Breast cancer mortality rates increased among both Maori and Pacific females, compared to decreases among non-Maori non-Pacific females. By 1996–99, non-Maori non-Pacific breast cancer mortality rates were 60% of those for Maori.

Pacific breast cancer mortality rates appear to have become the highest of all three ethnic groups in the 20-year period (although 95% confidence intervals include the Maori female rate). At the beginning of the 20-year period, Pacific breast cancer mortality rates were clearly the lowest of the three ethnic groups. In the early 1980s, Maori had colorectal cancer mortality rates one-third (females) to two-thirds (males) of those for non-Maori non-Pacific people.

In contrast to increasing rates among Maori, minor decreases in age-standardised mortality rates among non-Maori non-Pacific people over the last 20 years, have resulted in similar colorectal cancer mortality rates by the late 1990s. While rates are imprecise for Pacific people, it appears that there has been an even more substantial increase in colorectal cancer mortality among this group. At the end of the 20-year period, all three ethnic groups have roughly comparable colorectal cancer rates.

Ischaemic heart disease mortality rates tended to decrease over time for all ethnic groups and both sexes—although not much for Maori and Pacific males, thus resulting in widening gaps. Stroke mortality rates were clearly highest for Pacific people among males and (possibly) females. All ethnic groups had decreasing stroke mortality rates over time. Respiratory disease mortality decreased for all three ethnic groups. However, there were always large excesses of Maori male and female respiratory mortality compared to non-Maori non-Pacific people, and likewise for Pacific males (Figure 4).

Unintentional injury mortality rates decreased over time for all ethnic groups and both sexes. This pattern was similar for road traffic crashes—a major contributor to unintentional injuries (not shown here). Suicide rates increased most notably among both Maori males and females over the 1980s and 1990s. Increasing suicide mortality for Pacific and non-Maori non-Pacific males was also evident—but the increases were not as marked as for Maori (Figure 5).

Discussion

This paper presents mortality rates by ethnicity for the 1980s and 1990s. Most importantly, the underlying mortality data have been corrected for numerator–

denominator bias for the first time in New Zealand. There are clear and concerning patterns.

Most notably, there has been little (if any) decline in Maori and Pacific mortality rates over these two decades (1980s and 1990s) despite a steady decline in non-Maori non-Pacific mortality. As a consequence of this divergent pattern by ethnicity in mortality trends, the inequalities between Maori and Pacific and non-Maori non-Pacific mortality have markedly increased over the last two decades.

By cause of death, decreasing mortality rates (for cardiovascular disease, respiratory disease, and unintentional injury) among Maori and Pacific people have been off-set by increasing cancer (both lung cancer and non-tobacco related cancers) and suicide mortality rates. Further, even for those diseases with decreasing rates over time among all ethnic groups (eg, ischaemic heart disease), the relative inequalities between ethnic groups have tended to increase over time.

Whilst these results are more accurate than previous official mortality statistics by ethnicity for the 1980s and 1990s, there are still two important limitations. First, our adjustment for numerator–denominator bias is unlikely to be exactly correct. We were only able to use approximately two-thirds of the eligible mortality records to calculate the adjustment factors. However, extensive sensitivity analyses lead us to conclude that the results are accurate.^{7,11} Second, the best we could do was to adjust ethnicity recording on mortality data to the self-identified ethnicity on the corresponding census.

The concept and recording of census ethnicity has varied for each of the 1981, 1986, 1991, and 1996 censuses. This instability of ethnic classifications is a major problem for the 1991 to 1996 census comparisons for Maori. That said, any change in the ethnic group composition over time is at the margin and will not alter the major finding of diverging ethnic mortality trends.

Why are we observing these diverging ethnic mortality trends? We believe this question requires attention from a range of researchers and analysts. For the purposes of this paper, we will outline three (not mutually exclusive) types of explanation: epidemiological, structural, and health services.

Epidemiologically, these patterns appear most consistent with period effects rather than age or cohort effects. The colorectal cancer trends among Pacific people are particularly notable, and presumably reflect the lag-time from exposure to Western lifestyles commencing in the late 1950s and 1960s following migration to New Zealand.

Lung cancer rates increased among both Maori and Pacific people (particularly females) during the 1980s and 1990s (in contrast to decreases among non-Maori non-Pacific males and a possible peaking of mortality in the early 1990s for non-Maori non-Pacific females). As the cause of death most strongly associated with tobacco, these mortality trends obviously reflect tobacco consumption trends by ethnicity that occurred a decade or so prior to the death event.

Regarding cancer generally, incidence rates overall are somewhat similar between ethnic groups for non-lung cancer,¹⁵ yet there are marked mortality differences. Development of cancer control strategies in New Zealand¹⁶ must address the

contribution of cancer to increasing ethnic mortality gaps. Projecting out 5 to 10 years based on the cardiovascular mortality trends in this paper, premature heart disease death is going to be uncommon among non-Maori non-Pacific. Consequently, health promotion programmes and treatment services to reduce heart disease need to increasingly focus on addressing Maori and Pacific populations.

Much of the disparities in mortality between ethnic groups are likely to be due to parallel disparities in classic risk factors for poor health such as tobacco. However, there is wide acceptance that socioeconomic factors are underlying determinants of health^{13,17-20} either by the way socioeconomic position determines risk factor exposures or by other mechanisms such as health services access.

Access to income, education, and other resources influences one's health by a myriad of pathways including behaviour, health services, and psychosocial mechanisms. Between 1980 and 1999, New Zealand underwent major social and economic changes including a substantially flattened tax system; fully targeted income support; a regressive consumption tax (GST); market rentals for housing; privatised major utilities; user-charges for health, education, and other government services; and a restructured labour market designed to facilitate 'flexibility'.²¹⁻²⁴

These social and macroeconomic changes did not impact equally on Maori and non-Maori. Indeed, inequalities between Maori and non-Maori widened in employment status, education, income, and housing—key social determinants of health.¹³

Specifically, unemployment rates for Maori rose from levels similar to non-Maori in the early 1980s to three times that of non-Maori in the late 1980s. Furthermore, real incomes of Maori households dropped during this period and did not recover to the level they were at in the early 1980s.²⁴⁻²⁶

The stasis in Maori mortality rates presented in this paper for the 1980s and 1990s was preceded by marked improvements in life expectancy in the 1950s to 1970s.^{12,27} Major structural change in the New Zealand economy and society, therefore, seemed to coincide with no further improvement in Maori health.

We do not contend that structural change is the full or only explanation for diverging ethnic mortality trends during the 1980s and 1990s. For example, many chronic diseases take years or decades to manifest, meaning that deaths during the 1980s and 1990s would have causal antecedents both during this period and prior. However, it is also very clear from ex-Soviet countries that sudden increases in mortality can rapidly follow social upheaval and change.^{28,29}

Therefore, we argue that structural change in New Zealand was a major contributor to the diverging ethnic mortality trends reported in this paper. Indeed, a prediction by Maori leaders at Hui Taumata in 1984 that the structural reform policies would make Maori the 'shock absorbers in the economy' seems to have materialised in health (and other social) statistics.

Health services are not responsible for all, or even the majority, of socioeconomic and ethnic inequalities in health;³⁰ however, they undoubtedly play a role. For example, US research found that co-payments discouraged visits for low-income people, irrespective of how medically necessary the visit was thought to be (including visits for preventive care).³¹ There is evidence that cost barriers are also an issue in New Zealand. An iwi general practice in Taranaki found the introduction of an \$8.00 part

charge for community cardholders led to a dramatic decrease in attendance (30%) among a group with extremely high health needs, and the co-payment was subsequently dropped.³²

Recent surveys in New Zealand have found that adults with below-average income were more likely to report having gone without needed care because of the cost.^{33,34} The Commonwealth Fund 2001 Survey also found that Maori adults were twice as likely as Pakeha to have gone without needed care in the past year because of the cost—partly reflecting income differences. However, even when controlling for income, access concerns were significantly higher for Maori.³³

A significant body of research examining ethnic health disparities in the United States has found that white Americans receive a higher quality of health services, and are more likely to receive even routine medical procedures than other ethnic groups. These differences were found to be associated with greater mortality among African-American patients.³⁵

The ratio of Maori to non-Maori mortality for all adult cancer is higher than the same ratio for disease incidence.¹⁵ This pattern is indicative of higher case fatality rates among Maori compared to non-Maori once they have cancer, suggesting an important role for health services to reduce ethnic inequalities. Despite higher mortality from cardiovascular disease, there is evidence that Maori and Pacific people receive fewer cardiac interventions than would be expected.³⁶ Westbrooke et al (2001) found that these differences remained even after controlling for sex, age, and deprivation (NZDep96).³⁷

Where to from here? There is clearly a need for further investigation, analysis, and understanding of the concerning trends in inequality shown in this paper. For example, the contribution of trends in a range of socioeconomic factors to trends in mortality by ethnicity needs more thorough analysis than that offered by considering just one socioeconomic factor or one point in time.^{8,38} Likewise, the contribution of health services and epidemiological risk factors needs further investigation. Such improved understanding should then translate into action to reduce ethnic inequalities in health.

Statistics New Zealand security statement

The New Zealand Census Mortality Study (NZCMS) is a study of the relationship between socioeconomic factors and mortality in New Zealand, based on the integration of anonymised population census data from Statistics New Zealand and mortality data from the New Zealand Health Information Service. The project was approved by Statistics New Zealand as a Data Laboratory project under the Microdata Access Protocols in 1997. The data sets created by the integration process are covered by the Statistics Act and can be used for statistical purposes only. Only approved researchers who have signed Statistics New Zealand's declaration of secrecy can access the integrated data in the Data Laboratory. (A full security statement is in a technical report at <http://www.wnmeds.ac.nz/nzcms-info.htm>) For further information about confidentiality matters in regard to this study, please contact Statistics New Zealand.

Author information: Tony Blakely, Senior Research Fellow; Shilpi Ajwani, Research Fellow; Bridget Robson, Research Fellow (Te Ropu Rangahau Hauora a Eru

Pomare), Department of Public Health, Wellington School of Medicine and Health Sciences, University of Otago, Wellington; Martin Tobias, Public Health Physician; Martin Bonné, Advisor; Ministry of Health, Wellington

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Correspondence: Tony Blakely, Department of Public Health, Wellington School of Medicine and Health Sciences, University of Otago, PO Box 7343, Wellington. Fax: (04) 389 5319; email: tblakely@wnmeds.ac.nz

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