Trends in mortality by neighbourhood income in urban Canada from 1971 to 1996

- *From 1971 to 1996, differences in life expectancy between the richest and poorest income quintiles diminished by well over 1 year for each sex.*
- *Differences in infant mortality declined by 7 per thousand (76%).*
- *The rate of income-related excess potential years of life lost before age 75 diminished by 35%.*
- *For most causes of death, socio-economic disparities in mortality diminished markedly over time. However, some causes of death showed little change, and a few showed clearly widening disparities.*

Abstract

Objectives

This article describes changes in income-related differences in mortality in Canada from 1971 to 1996, including trends by specific causes of death.

Data source

Death registration and population data for residents of census metropolitan areas (CMAs) were obtained from the Canadian Mortality Data Base and population censuses for 1971, 1986, 1991, and 1996. The death data were then coded to census tract (CT), and institutional residents were identified (for exclusion).

Analytical techniques

Within each CMA, the non-institutional population and deaths were grouped into neighbourhood income quintiles on the basis of the CT percentage of population below Canada's low-income cut-offs. Life expectancy at birth, probability of survival to age 75, potential years of life lost (PYLL), and income-related excess PYLL before age 75 were calculated, as were age-specific mortality rates and age-standardized mortality rates (ASMRs) for major causes of death.

Main results

From 1971 to 1996, differences in life expectancy between the richest and poorest income quintiles of urban Canada diminished by well over 1 year for each sex (from 6.3 to 5.0 years for males, and from 2.8 to 1.6 years for females). Inter-quintile differences in infant mortality declined by 7 per thousand (76%). The rate of income-related excess potential years of life lost (PYLL) before age 75 diminished by 35%. By 1996 the major causes of death contributing to excess PYLL were circulatory diseases, injuries, neoplasms, and infectious diseases. For most causes of death (notably ischemic heart disease, most injuries, cirrhosis of the liver, and perinatal conditions), socio-economic disparities in mortality diminished markedly over time. However, some causes of death (such as lung cancer, prostate cancer and suicide for males, and breast cancer for females) showed little change, while a few (lung cancer for females, and infectious diseases, mental disorders and diabetes for both sexes) showed clearly widening disparities.

Conclusions

Because of the multiple pathways through which such differences are believed to arise, continued progress in reducing socio-economic disparities in mortality in Canada may require both broad-based intersectoral policies and highly targeted interventions, as well as better data on the nature of the existing disparities with respect to socio-economic characteristics other than neighbourhood income.

Key words

infant mortality, life expectancy, survival probability, premature mortality, excess deaths, age-standardized mortality rate, population-attributable risk

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The reduction of socio-economic inequities in health—"Health for All"—is an explicit objective of health policy in Canada.[1-3] Many studies in various countries have shown that all-cause mortality, as well as mortality for specific causes of death, is considerably higher among people of lower socio-economic status.[4-7] In Canada an increasing number of studies have confirmed such patterns using individual-level socio-economic data[8-24] as well as small area-based socio-economic data.[25-35]

Internationally, the findings for trends over time are inconsistent. Some studies have reported a widening of socio-economic disparities in mortality,[36-41] while others have reported a narrowing of such differences,[28, 42-43] and a few have reported changes in both directions, depending on the time period.[39, 44] Only two Canadian studies, neither of them recent, have provided information on how income-related disparities in mortality rates have changed over

Methods

Data sources

Death registration and population data for residents of Canadian census metropolitan areas (CMAs) were obtained from the Canadian Mortality Data Base and population censuses for 1971, 1986, 1991, and 1996. CMAs, which account for about 60% of Canada's total population, were used because neighbourhoods are more clearly defined and residential segregation by income is more pronounced in big cities than in small towns and rural areas.

Variables extracted from the Canadian Mortality Data Base included age, sex, marital status, place of birth, census subdivision (municipality) of usual place of residence, and cause of death. From microfilm records, optical images, and supplementary electronic files, the street address, city, and postal code (if available) were also obtained for each death to establish the census tract (CT) of usual place of residence and to determine if the decedent resided in a long-term care facility (for further information, see *Restrictions and coding to CT and quintile*[48-52] and Appendix Table A). For 1971, data already coded to CT and with institutional residents identified were obtained from a tape created by Statistics Canada for a previous study.[25]

Deaths of residents of long-term care facilities were excluded because the income level of the CT in which an institution was located might be unrelated to the income of its residents. A smaller number of deaths were excluded because the CT of residence could not be coded, because CT income data were not available, or because age or sex was unknown (Table 1). After these exclusions, approximately 357,000 deaths (74,000 in 1971, 88,000 in 1986, 93,000 in 1991, and 102,000 in 1996) were available for analysis by quintile. These represented approximately 98% of non-institutional deaths in 1971 and at least 99% of non-institutional deaths in subsequent years.

Causes of death had been coded according to the International Classification of Diseases (ICDA-8[53] in 1971 and ICD-9[54] in subsequent years) and were analyzed by ICD chapter and by common specific causes within chapters (see Appendix Table B). For 1986 only, deaths due to acquired immune deficiency syndrome were reallocated from metabolic disorders (ICD-9 279.1) to infectious diseases (ICD-9 042.9) for comparability with coding for subsequent years.

For 1986, 1991, and 1996, the total population less residents of long-term care facilities (14.9 million in 1986, 16.5 million in 1991, and 17.7 million in 1996) was used as the denominator for calculating mortality rates. For 1971, the total population (11.6 million) was used instead, since the 1971 census coding of type of collective dwelling was considered unreliable. The study base thus consisted of 60.7 million person-years at risk.

Analytical techniques

Abridged life tables for 1971, 1986, 1991, and 1996 and corresponding standard errors for life expectancy and the probability of survival to each age were calculated for each income quintile and sex according to the method of Chiang,[55] except that life expectancy for the last age interval (95+) was taken as the inverse of the age-specific mortality rate. Life tables for both sexes together were constructed by combining the columns for survivors and life years lived from the life tables for each sex, rather than using mortality rates based on pooled death and population data. This ensured that the actual distribution of the population by age and sex would have no effect on the life table results.

Potential years of life lost (PYLL) before age 75 was calculated as described by Romeder and McWhinnie,[56] except that infant deaths and deaths from ages 70 to 74 were included. Excess PYLL was defined as the difference between observed and expected PYLL, where expected PYLL was that which would have occurred if the age- and sex-specific mortality rates in the richest quintile had applied to the total population.

Confidence intervals for the age-specific mortality rates were calculated by the method of Fleiss.[57] The inter-quintile mortality rate ratio was calculated as the rate for the poorest quintile divided by the rate for the richest quintile. Mortality rate differences were calculated as the rate for the poorest quintile (or total) less that for the richest quintile. Confidence intervals for the rate ratios and rate differences were calculated as described by Rothman[58] and Kelsey et al.[59] Survivorship differences were expressed as the percentage of the population in the richest quintile that was expected to survive to a given age, less the percentage of the population in the poorest quintile that was expected to survive to that age.

Age-standardized mortality rates (ASMRs) for each sex were calculated by the direct method, with the 1986 CMA population (excluding residents of long-term care facilities) as the reference population. ASMRs for both sexes together were standardized by sex as well as by age. Standard errors for the ASMRs were calculated as described by Spiegelman[60] and Brillinger;[61] this method assumes a binomial distribution of the rates in each stratum. Asymmetric confidence intervals for the ASMRs were calculated by the method of Carrière and Roos,[62] which assumes a Poisson distribution of the deaths in each stratum. Inter-quintile mortality rate ratios for the ASMRs were calculated as the ratio of the ASMR in the poorest quintile divided by the ASMR in the richest quintile. Inter-quintile mortality rate differences compared the ASMR of the poorest quintile with that of the richest quintile. Excess mortality was defined as the ASMR for the total population less the ASMR of the richest quintile. Confidence intervals for the population-attributable risk percentages were calculated according to the method of Fleiss.[57]

time.[27,28] Furthermore, trends for certain specific causes of death differed from those for all-cause mortality.[28, 45,46] In some cases, the direction of trends also differed according to whether rate ratio or rate difference measures were used.[47]

This study fills an important gap since it examines changes in mortality rates by income in urban Canada over a recent 25-year period. The objective was to determine if income-related differences in mortality rates have changed since the early 1970s, and if so, by how much, in which period, and for what ages and which causes of death.

Demographic and socio-economic characteristics

We divided the population into fifths (quintiles) based on the percentage of population in their neighbourhood (CT) below the low-income cut-offs (see *Restrictions and coding to CT and quintile*). Because the population increased, the number of people of each sex in each neighbourhood income quintile grew from about 1.1 million in 1971 to 1.7 million in 1996 (Table 2). The number of deaths per quintile and sex varied from a low of just over 4,000 for females of the richest quintile in 1971 to a high of over 14,000 for males of the poorest quintile in 1986.

The percentage of residents classified as low income in each quintile was generally similar in 1971, 1986, and 1991, but the gradient between the poorest and richest quintiles was noticeably steeper in 1996 (Chart 1).

Table 1
Total deaths, deaths excluded from analysis (by reason for exclusion), and non-institutional population, urban Canada, 1971 to 1996

	1971	1986	1991	1996
Total deaths in study area	81,465	104,104	109,960	122,104
Death registrations not retrieved	18	0	0	0
Residents of health care facilities	5,912	14,835	16,510	19,185
Census tract not coded	1,375	923	17	1,010
Census tract excluded	109	213	97	122
Age or sex unknown	61	4	8	1
Deaths remaining for analysis by quintile	73,990	88,129	93,328	101,786
Non-institutional population for analysis	11,605,660	14,946,360	16,503,465	17,690,820

Data source: *Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
Notes: *The 1971 and 1986 analysis files were restricted to deaths for which income quintile was known. The 1991 and 1996 analysis files included 79 and 1023 deaths, respectively, that were not classified by income quintile. Census tracts were excluded either because of missing income data or high rate of non-response to census.*

From 1971 to 1996, the percentage of the population born outside of Canada diminished for quintile 1 (the richest), stayed roughly the same for quintile 2, and grew substantially for quintiles 3, 4, and 5 (Chart 2).

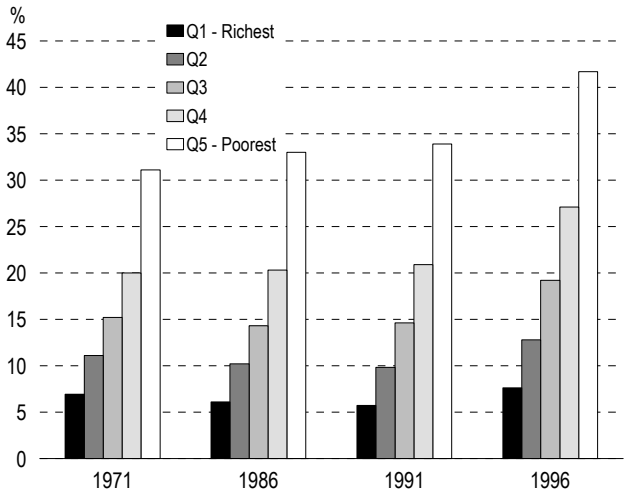
Other socio-economic characteristics also varied systematically by quintile[63] (see values for 1996 in Table 3). Thus, the poorer quintiles had not only a lower average household income, but also a higher percentage of renters, lower levels of education, higher unemployment, and a lower percentage of people with professional and managerial occupations.

Table 2
Non-institutional deaths and population by neighbourhood income quintile and sex, urban Canada, 1971 to 1996

	1971			1986			1991			1996		
	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females
Deaths												
Total	73,990	42,974	31,016	88,129	49,462	38,667	93,407	52,175	41,232	102,809	55,929	46,880
Quintile 1 (richest)	9,488	5,359	4,129	11,794	6,607	5,187	12,330	6,932	5,398	15,268	8,359	6,909
Quintile 2	11,815	6,755	5,060	14,308	8,030	6,278	15,176	8,440	6,736	17,076	9,327	7,749
Quintile 3	14,200	8,062	6,138	17,105	9,509	7,596	18,784	10,427	8,357	19,974	10,811	9,163
Quintile 4	16,054	9,090	6,964	19,609	10,887	8,722	21,881	12,068	9,813	23,347	12,495	10,852
Quintile 5 (poorest)	22,433	13,708	8,725	25,313	14,429	10,884	25,157	14,267	10,890	26,121	14,384	11,737
Population ('000)												
Total	11,606	5,728	5,878	14,946	7,313	7,633	16,503	8,090	8,414	17,691	8,647	9,044
Quintile 1 (richest)	2,231	1,111	1,120	2,908	1,449	1,459	3,312	1,656	1,654	3,634	1,808	1,827
Quintile 2	2,307	1,139	1,168	2,980	1,476	1,503	3,275	1,616	1,659	3,509	1,725	1,784
Quintile 3	2,323	1,143	1,180	2,995	1,458	1,538	3,334	1,619	1,714	3,524	1,708	1,815
Quintile 4	2,324	1,137	1,186	2,984	1,434	1,551	3,332	1,607	1,725	3,517	1,694	1,823
Quintile 5 (poorest)	2,421	1,199	1,222	3,079	1,496	1,582	3,248	1,589	1,660	3,500	1,708	1,791

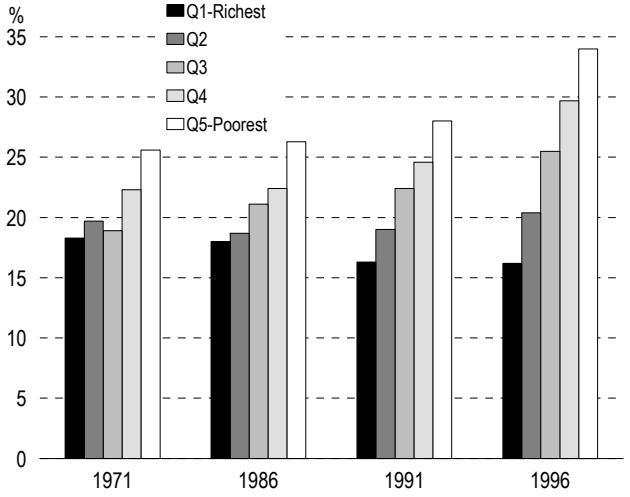
Data source: *Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
Note: *For 1991 and 1996, total deaths include those for which income quintile was unknown (not shown separately).*

Chart 1
Low income: percentage of population below the low-income cut-offs, by neighbourhood income quintile, urban Canada, 1971 to 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

Chart 2
Foreign-born: percentage of population born outside Canada, by neighbourhood income quintile, urban Canada, 1971 to 1996



***Data sources**: Census tract profile data for non-institutional population[63]; special tabulations.*

Table 3
Socio-economic characteristics of each neighbourhood income quintile, urban Canada, 1996

Income quintile	Low income	Average household income	IPPE†	Income from gov't transfers	Housing owned	Foreign born	Recent immi-grants‡	Unem-ployed§	Managerial professional occupations††	Low education‡‡ (<9 years)	Lone parent families§§
	%	$	$	%	%	%	%	%	%	%	%
Total	21.5	51,718	34,901	12.1	58.6	25.1	5.6	9.3	9.8	10.4	23.3
Quintile 1 (richest)	7.6	72,944	45,592	7.3	84.7	16.2	2.7	6.1	13.2	5.7	13.4
Quintile 2	12.8	61,780	39,636	9.6	75.7	20.4	4.1	7.3	11.0	8.1	17.4
Quintile 3	19.2	52,880	35,393	12.0	62.2	25.5	5.6	8.7	9.5	9.8	22.8
Quintile 4	27.1	43,921	30,616	15.3	49.4	29.7	6.9	10.6	8.1	13.0	28.5
Quintile 5 (poorest)	41.7	33,421	24,531	20.3	30.2	34.0	8.6	14.5	6.7	15.2	37.8

***Data source:** 1996 census tract profile data for non-institutional population[63]*
Notes: † Income per person-equivalent (average household income adjusted for household size).
‡ Immigrants who arrived from 1981 to 1991, as a percentage of all persons aged 5 or older.
§ As percentage of labour force aged 15 and over.
†† Includes occupations in managerial, administrative, teaching, and related occupations, as well as occupations in medicine and health.
‡‡ As percentage of population aged 15 and over.
§§ As percentage of all families with children at home.

General mortality trends

The results that follow show that from 1971 through 1996 there was a general pattern of decline in mortality rates for all income quintiles, for both sexes, and for most causes of death. Throughout this 25-year period, the most common pattern was of an income gradient in mortality whereby the richest quintile had the lowest mortality rates and the poorest quintile the highest. These income gradients generally persisted over time, although they tended to be less steep in the more recent years, particularly for females.

Restrictions and coding to CT and quintile

Study areas. In 1986, 1991, and 1996, 25 urban agglomerations were defined by Statistics Canada as census metropolitan areas (CMAs) on the basis of population size and commuting flows, and all of these were included in the study. The 25 CMAs represented roughly 60% of the total Canadian population in those years. In 1971, 22 urban agglomerations in Canada met the CMA definition, but one (Chicoutimi-Jonquière) was excluded because census tract (CT) reference information was not available when the coding was done for the earlier study.[25] The analysis for 1971 was therefore based on 21 CMAs representing 54% of the total Canadian population.

Geographic coding. Street address data from death registrations were used to code the CT of usual place of residence of each deceased person (CTs are socially-homogeneous small areas (neighbourhoods) with a typical population of 4,000). For 1971, the coding was done manually on the basis of street indexes and maps. For 1986, 1991, and 1996, postal codes were generated from addresses, validated, and then converted to CT by means of an enhanced version of the Statistics Canada Postal Code Conversion File (for the most recent version, see reference 48). For 1986, addresses for which no postal code could be found or for which the postal code was linked only to post office location (such as for rural route delivery and post office boxes) were manually assigned to CT by means of street indexes, maps, and other reference documents. For 1991 and 1996, most such codes were probabilistically assigned in proportion to the distribution of census population by postal code and CT.

Identification of institutional residents in the death data. For 1971, addresses of long-term care facilities were compiled from various sources and compared with those of decedents. For 1986, 1991, and 1996, Statistics Canada lists of health care facilities were used to identify institutions, and deaths of residents of facilities with 10 or more beds were excluded. If a facility's postal code was unique to the institution, residents of the facility were excluded automatically on the basis of their postal code. If the postal code was not unique to the institution, street addresses and facility names (if given) were used to determine if the decedent was a usual resident of a long-term care facility.

Exclusion of CTs. In each of the study years, any CT with a non-reserve private household population (the denominator used to calculate percentage of low-income residents) of less than 250 was excluded because for these CTs census data on income were suppressed. Institutional CTs with few or no private households, industrial CTs with little or no population of any kind, and most Indian reserves were thus excluded. However, a few smaller reserves were included as part of larger CTs. In 1986, 1991, and 1996, three other CTs containing larger but incompletely enumerated Indian reserves were also excluded.

Construction of quintiles. The population of each CMA was divided into five quintiles as follows. Persons, excluding institutional residents and status Indians on reserves, were classified as having low income if their total economic family (or unattached individual) income in the year preceding the census was below that year's Statistics Canada low-income cut-off, which varied according to family size and CMA size (see Appendix Table A).[49-52] Each CT within the CMA was then ranked according to percentage of population below the low-income cut-off, and the CTs were assigned to five groups from lowest to highest percentage of low-income residents, such that each of the five groups of CTs contained approximately one-fifth of the total non-institutional population of the CMA. The quintile data were then pooled across CMAs.

Note concerning the quintiles. Relative rather than absolute income was used to define the quintiles, such that each quintile represented a fifth of the population ranked by income, regardless of how income distribution changed over time. In comparisons of quintiles, quintile 5 is referred to as the poorest (with the highest percentage of population below the low-income cut-off) and quintile 1 as the richest (with the lowest percentage of population below the low-income cut-off).

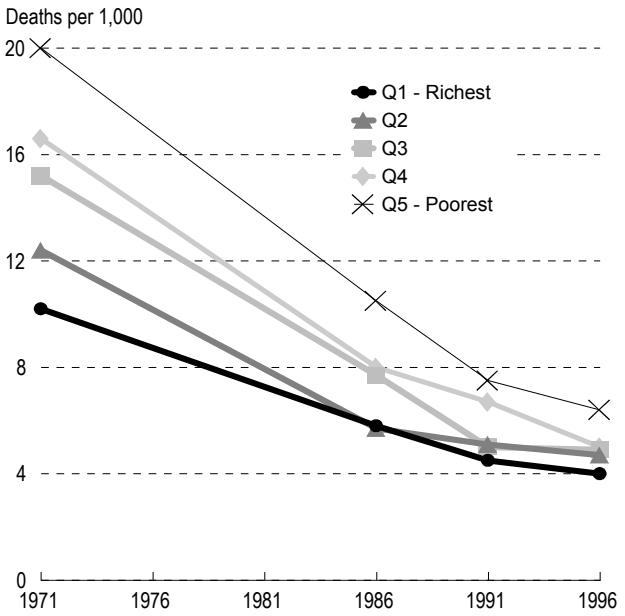
Infant mortality rates

The infant mortality rates (deaths before age 1) in each of the income quintiles declined over the 25-year study period (Chart 3, Table 4). The inter-quintile rate difference (quintile 5 minus quintile 1) fell from 9.8 per thousand in 1971 to 2.4 per thousand in 1996. Thus, the disparity between the poorest and the richest quintiles diminished markedly in terms of rate differences, although the decline was much less impressive in terms of rate ratios (from 1.97 in 1971 to 1.61 in 1996).

Nevertheless, the rate differences are more relevant to the public health impact of the changes observed. If the rate in the richest quintile had applied to all urban Canada, and the same relative rates had also been experienced by non-metropolitan areas, then there would have been approximately 2000 fewer infant deaths in 1971, compared to only about 500 fewer in 1996.[35]

In 1996, infant mortality in Canada's poorest neighbourhoods, 6.4 deaths for every 1,000 live births, was considerably lower than the national rate for the United States (7.8). However, the rate in Canada's richest neighbourhoods was no better than Sweden's national rate (4.0).

Chart 3
Infant mortality rates, by neighbourhood income quintile, urban Canada, 1971 to 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

Mortality rate ratios at various ages

With few exceptions, the higher the percentage of low-income population in a quintile, the higher the age-specific mortality rate (data not shown). In many respects, trends in mortality rates by income at most other ages were similar to those for infant mortality: in most income quintiles the mortality rate declined over time, but the inter-quintile rate ratios tended to diminish to a much lesser extent. However, the absolute improvements for the poorer quintiles were generally greater than those for the other quintiles, so the rate differences usually diminished over time.

In general, the pattern of inter-quintile mortality rate ratios—expressed as the mortality rate in the poorest quintile divided by the rate in the richest quintile—was similar over time (Table 5). Disparities were largest in infancy (age less than 1) and during the prime working years (ages 25 to 64). Disparities were smallest for ages 15 to 24 and 75 or older. There were exceptions for children ages 1 to 14, for whom rates were extremely low and unstable, and for men ages 35 to 44, for whom rate ratios increased markedly from 1986

Table 4
Infant mortality rate per 1000 by neighbourhood income quintile, urban Canada, 1971 to 1996 (95% confidence intervals in parentheses)

	1971		1986		1991		1996	
Total	15.0	(14.5, 15.6)	7.5	(7.2, 7.9)	5.8	(5.5, 6.1)	5.1	(4.8, 5.4)
Quintile 1 (richest)	10.2	(9.1, 11.3)	5.8	(5.1, 6.6)	4.5	(4.0, 5.2)	4.0	(3.4, 4.6)
Quintile 2	12.4	(11.3, 13.1)	5.7	(5.0, 6.5)	5.1	(4.5, 5.8)	4.7	(4.1, 5.4)
Quintile 3	15.2	(14.0, 16.5)	7.7	(6.9, 8.6)	5.0	(4.4, 5.7)	4.9	(4.2, 5.5)
Quintile 4	16.6	(15.3, 17.9)	8.0	(7.2, 8.9)	6.7	(6.0, 7.5)	5.0	(4.4, 5.7)
Quintile 5 (poorest)	20.0	(18.6, 20.5)	10.5	(9.6, 11.6)	7.5	(6.7, 8.3)	6.4	(5.7, 7.1)
Rate difference (Q5 - Q1)	9.8	(8.1, 11.6)	4.8	(3.5, 6.0)	2.9	(1.9, 3.9)	2.4	(1.5, 3.3)
Rate ratio (Q5/Q1)	1.97	(1.73, 2.23)	1.82	(1.56, 2.13)	1.64	(1.39, 1.94)	1.61	(1.34, 1.93)
Excess (Total - Q1)	4.9		1.8		1.2		1.1	
Excess % (Total - Q1)/Total	32		23		21		22	

***Data source:** Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
***Note:** Census population aged less than 1 used as denominator. Rate differences and rate ratios calculated with unrounded data.*

Table 5
Inter-quintile mortality rate ratios (Q5/Q1) by age group and sex, urban Canada, 1971 to 1996 (95% confidence intervals in parentheses)

Age group (years)	Males								Females							
	1971		1986		1991		1996		1971		1986		1991		1996	
< 1	1.99	(1.68, 2.35)	2.02	(1.64, 2.49)	1.65	(1.31, 2.08)	1.75	(1.37, 2.24)	1.94	(1.59, 2.35)	1.59	(1.27, 2.00)	1.59	(1.24, 2.03)	1.44	(1.10, 1.89)
1-14	1.62	(1.27, 2.05)	1.82	(1.32, 2.50)	1.78	(1.30, 2.45)	1.65	(1.18, 2.32)	1.70	(1.30, 2.50)	1.17	(0.84, 1.64)	1.49	(0.98, 2.24)	1.84	(1.26, 2.69)
15-24	1.24	(1.03, 1.49)	1.10	(0.91, 1.33)	1.27	(1.04, 1.56)	1.06	(0.86, 1.31)	1.26	(0.93, 1.72)	1.20	(0.89, 1.63)	1.18	(0.84, 1.64)	1.21	(0.88, 1.66)
25-34	1.68	(1.38, 2.05)	1.95	(1.66, 2.30)	1.83	(1.58, 2.12)	1.82	(1.55, 2.14)	1.74	(1.32, 2.28)	1.84	(1.42, 2.39)	1.52	(1.20, 1.92)	2.15	(1.63, 2.82)
35-44	2.29	(2.00, 2.62)	2.40	(2.09, 2.74)	3.34	(2.94, 3.81)	3.24	(2.87, 3.66)	1.87	(1.57, 2.23)	1.70	(1.42, 2.03)	2.06	(1.74, 2.42)	2.00	(1.71, 2.35)
45-54	2.11	(1.92, 2.31)	2.34	(2.12, 2.58)	2.37	(2.15, 2.62)	2.61	(2.37, 2.88)	1.59	(1.41, 1.80)	1.62	(1.42, 1.85)	1.63	(1.43, 1.85)	1.65	(1.46, 1.85)
55-64	1.63	(1.52, 1.76)	1.98	(1.85, 2.11)	1.89	(1.76, 2.03)	1.88	(1.75, 2.02)	1.43	(1.29, 1.58)	1.44	(1.31, 1.58)	1.57	(1.43, 1.73)	1.51	(1.37, 1.65)
65-74	1.48	(1.39, 1.59)	1.55	(1.46, 1.64)	1.67	(1.58, 1.77)	1.49	(1.42, 1.57)	1.15	(1.06, 1.25)	1.31	(1.22, 1.40)	1.32	(1.23, 1.41)	1.29	(1.21, 1.38)
75-84	1.21	(1.13, 1.30)	1.18	(1.12, 1.26)	1.14	(1.07, 1.21)	1.18	(1.12, 1.24)	1.06	(0.99, 1.14)	0.99	(0.93, 1.06)	0.96	(0.90, 1.02)	0.99	(0.94, 1.05)
85+	1.24	(1.11, 1.37)	0.95	(0.87, 1.04)	1.04	(0.95, 1.13)	0.96	(0.89, 1.03)	0.96	(0.88, 1.04)	0.81	(0.75, 0.87)	0.75	(0.73, 0.80)	0.77	(0.73, 0.82)

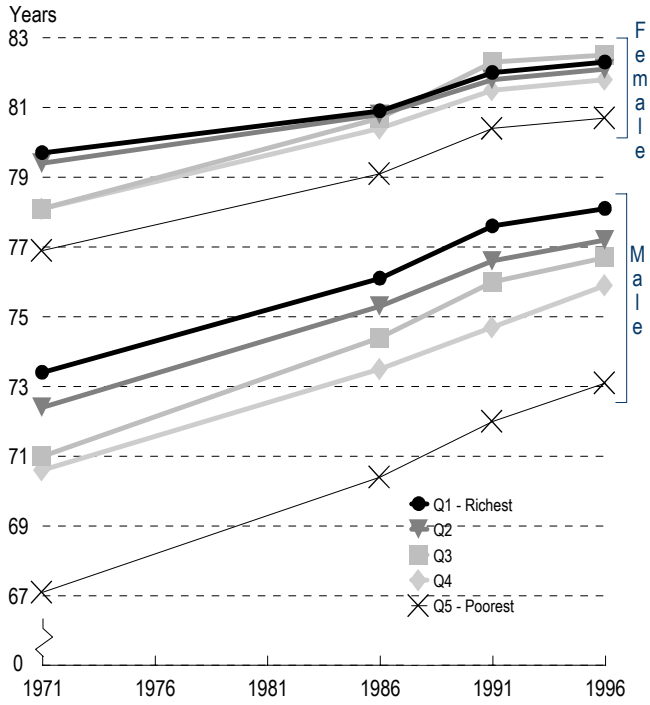
Data source: *Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

to 1991 (primarily because of acquired immune deficiency syndrome [AIDS]). From 1986 onward, the mortality rate ratios for non-institutionalized women age 85 or older were considerably less than 1.00, that is, rates were higher in the richest quintile compared to the poorest quintile.

Life expectancy at birth

For both sexes together (not shown) and for males in all years, as well as for females in 1971, the poorer the neighbourhood, the shorter the life expectancy of its residents (Chart 4, Table 6). For females from 1986 onward, the three richest quintiles (1, 2, and 3) were not significantly different from each other in terms of life expectancy. But for both males and females in all years, the poorest quintile was particularly disadvantaged, in that the difference in life expectancy between the poorest and next-poorest quintiles (quintiles 5 and 4 respectively) was always greater than the difference between any other adjoining quintiles. Nevertheless, there were substantial gains in life expectancy for all quintiles from 1971 to 1996, and the gains in life expectancy were greater for quintile 5 than for quintile 1.

Chart 4
Life expectancy at birth, by neighbourhood income quintile, by sex, urban Canada, 1971 to 1996



Data sources*: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

Table 6
Life expectancy at birth (in years), by neighbourhood income quintile and sex, urban Canada, 1971 to 1996 (95% confidence intervals in parentheses)

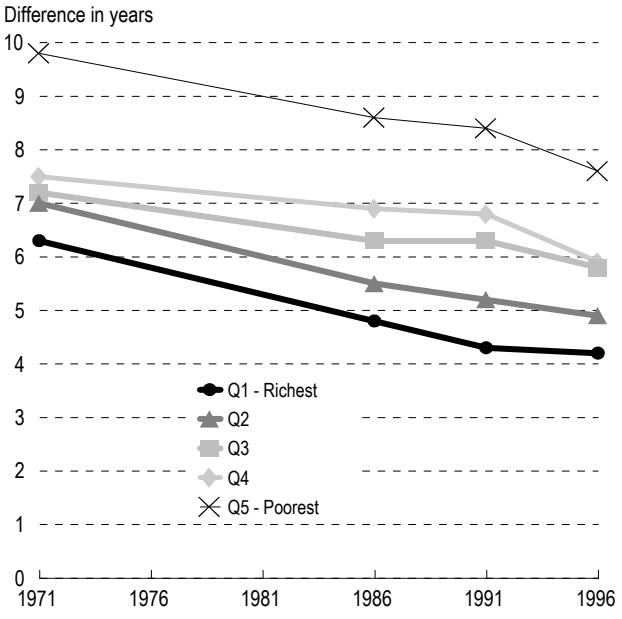
Income quintile	Males								Females							
	1971		1986		1991		1996		1971		1986		1991		1996	
Total	70.6	(70.4,70.7)	73.8	(73.7,73.9)	75.3	(75.2, 75.4)	76.0	(75.9, 76.1)	78.4	(78.2, 78.5)	80.4	(80.3, 80.5)	81.6	(81.5, 81.6)	81.8	(81.7, 81.9)
Quintile 1 (richest)	73.4	(73.0,73.7)	76.1	(75.8,76.3)	77.6	(77.4, 77.9)	78.1	(77.9, 78.3)	79.7	(79.4, 80.1)	80.9	(80.6, 81.2)	82.0	(81.7, 82.2)	82.3	(82.1, 82.6)
Quintile 2	72.4	(72.1,72.7)	75.3	(75.1,75.6)	76.6	(76.3, 76.8)	77.2	(76.9, 77.4)	79.4	(79.1, 79.8)	80.8	(80.6, 81.1)	81.8	(81.6, 82.1)	82.1	(81.8, 82.3)
Quintile 3	71.0	(70.7,71.3)	74.4	(74.1,74.6)	76.0	(75.7, 76.2)	76.7	(76.5, 76.9)	78.1	(77.8, 78.5)	80.7	(80.5, 80.9)	82.3	(82.1, 82.5)	82.5	(82.2, 82.7)
Quintile 4	70.6	(70.3,70.9)	73.5	(73.2,73.7)	74.7	(74.4, 74.9)	75.9	(75.7, 76.1)	78.1	(77.8, 78.5)	80.4	(80.1, 80.6)	81.5	(81.3, 81.7)	81.8	(81.6, 82.0)
Quintile 5 (poorest)	67.1	(66.8,67.4)	70.4	(70.2,70.7)	72.0	(71.7, 72.2)	73.1	(72.8, 73.3)	76.9	(76.6, 77.2)	79.1	(78.8, 79.3)	80.4	(80.2, 80.7)	80.7	(80.5, 80.9)
Q1 - Q5	6.3		5.6		5.7		5.0		2.8		1.8		1.6		1.6	
Q1 - Total	2.8		2.3		2.4		2.0		1.4		0.5		0.3		0.5	

Data source: *Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
Notes: *Rate differences calculated with unrounded data.*

In 1971, the disparity in life expectancy between the richest and poorest quintiles was over 6 years for men and nearly 3 years for women. By 1996, the inter-quintile disparity had diminished to 5 years for men and to considerably less than 2 years for women. The inter-quintile disparity reveals how much life expectancy people in the poorest income quintile would gain if their mortality rates were as low as those of the richest quintile. Also of interest is the difference in life expectancy between the richest quintile and the entire population, which reveals how much the population as a whole would gain if everyone were subject to the mortality rates of the richest quintile. In 1971, this value was nearly 3 years for males and almost 17 months for females, whereas in 1996, the difference was 2 years for males and just 6 months for females.

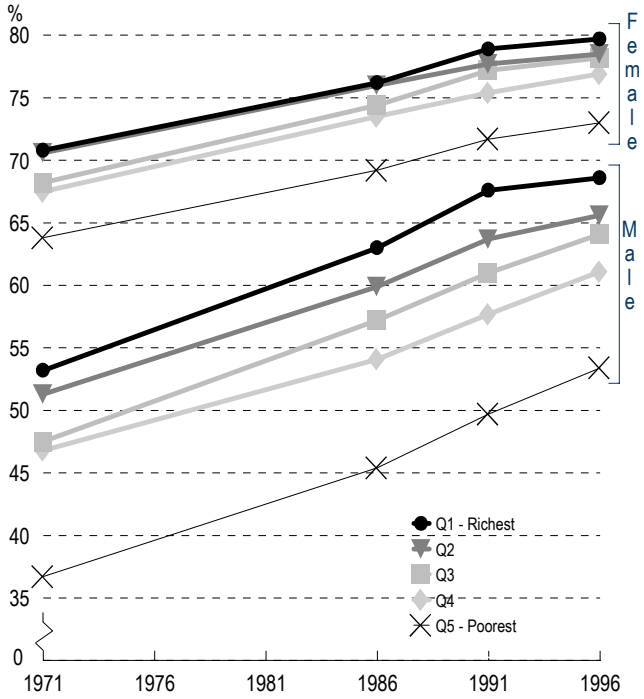
In all four study years, the gap in life expectancy at birth between males and females was greater in each successively poorer income quintile (Chart 5). However, in all quintiles, that gap diminished between 1971 and 1996.

Chart 5
Female-male difference in life expectancy at birth, by neighbourhood income quintile, urban Canada, 1971 to 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

Chart 6
Probability of survival to age 75, by neighbourhood income quintile, by sex, urban Canada, 1971 to 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

Probability of survival to age 75

In all four study years, the difference between the richest and poorest quintiles in the percentage of the population expected to survive from birth to a given age increased for both sexes up to age 75 and then decreased for older ages (data not shown).

For the probability of survival to age 75, the gradients by income were similar in 1971 and 1996 (Chart 6, Table 7). In 1996, 53% of males in the poorest quintile and 69% of those in the richest quintile were expected to survive to age 75 (Chart 7). For women, the corresponding figures were 73% and 80% (Chart 8).

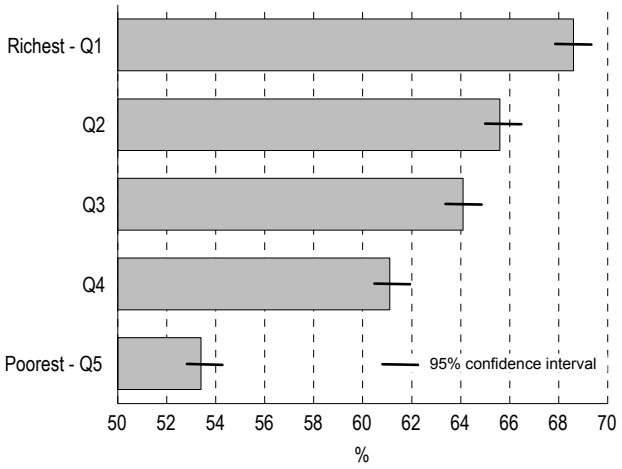
Between 1971 and 1996, men's chances of surviving to age 75 improved by an average of 16 percentage points, whereas women's chances (which were already much better) improved by 9 percentage points. Improvements were spread nearly evenly across the quintiles, so the magnitude of the inter-quintile differences was approximately the same over the 25-year period.

Table 7
Probability of survival to age 75 (as percentage) by neighbourhood income quintile and sex, urban Canada, 1971 to 1996 (95% confidence intervals in parentheses)

Income quintile	Males								Females							
	1971		1986		1991		1996		1971		1986		1991		1996	
Total	45.8	(45.4,46.3)	55.2	(54.8,55.6)	59.4	(59.0, 59.7)	62.1	(61.8, 62.5)	67.9	(67.4, 68.3)	73.6	(73.2, 73.9)	75.9	(75.6, 76.2)	77.0	(76.7, 77.3)
Quintile 1 (richest)	53.2	(51.9,54.5)	63.0	(62.0,63.9)	67.6	(66.7, 68.5)	68.6	(67.8, 69.4)	70.8	(69.6, 71.9)	76.2	(75.4, 77.1)	78.9	(78.1, 79.7)	79.7	(79.0, 80.4)
Quintile 2	51.3	(50.2,52.5)	59.9	(58.9,60.8)	63.7	(62.8, 64.5)	65.6	(64.8, 66.4)	70.6	(69.6, 71.6)	76.0	(75.2, 76.8)	77.7	(77.0, 78.5)	78.5	(77.8, 79.1)
Quintile 3	47.5	(46.5,48.6)	57.2	(56.4,58.1)	61.0	(60.2, 61.8)	64.1	(63.3, 64.8)	68.2	(67.3, 69.2)	74.4	(73.7, 75.2)	77.2	(76.5, 77.8)	78.2	(77.6, 78.8)
Quintile 4	46.8	(45.8,47.7)	54.1	(53.3,54.9)	57.7	(56.9, 58.4)	61.1	(60.4, 61.9)	67.5	(66.6, 68.4)	73.5	(72.8, 74.2)	75.4	(74.8, 76.1)	76.9	(76.3, 77.5)
Quintile 5 (poorest)	36.7	(35.9,37.5)	45.4	(44.7,46.2)	49.7	(48.9, 50.4)	53.4	(52.7, 54.2)	63.8	(63.0, 64.7)	69.2	(68.5, 69.9)	71.7	(71.0, 72.4)	73.0	(72.3, 73.6)
Q1 - Q5	16.5		17.5		17.9		15.2		6.9		7.1		7.2		6.7	
Q1 - Total	7.4		7.7		8.2		6.5		2.9		2.7		3.0		2.7	

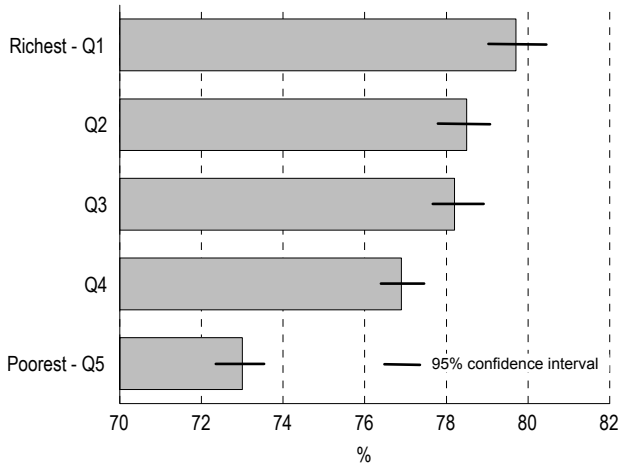
Data source: *Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
Notes: *Rate differences calculated with unrounded data.*

Chart 7
Probability of survival to age 75, by neighbourhood income quintile, males, urban Canada, 1996



Data sources*: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

Chart 8
Probability of survival to age 75, by neighbourhood income quintile, females, urban Canada, 1996



Data sources*: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

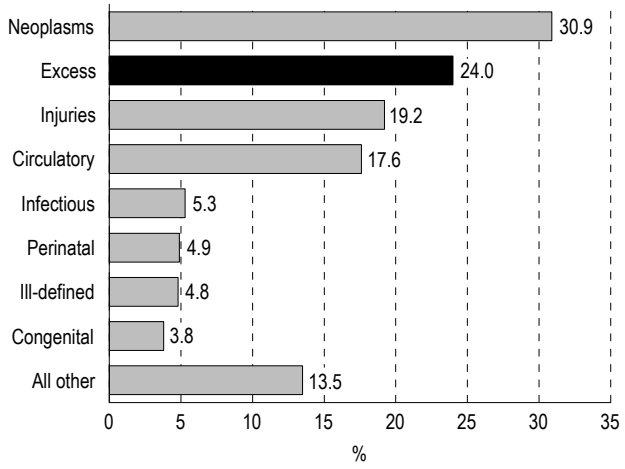
Potential years of life lost before age 75

In 1996, the most important causes of potential years of life lost (PYLL) from birth to age 74 were neoplasms (all cancers), followed by injuries (both intentional and unintentional) and circulatory diseases (Chart 9). Excess PYLL—the percentage of total PYLL that was related to income differences—was 24%, which is greater than that due to all injuries or to circulatory diseases. Elimination of excess PYLL would result in gains in potential years of life equivalent to eradicating one of the three leading causes of death.

The major causes of death contributing to income-related excess PYLL in 1996 were circulatory diseases, injuries, neoplasms, and infectious diseases (Chart 10). The first three of these were the same as for total PYLL, except in reverse order. Circulatory diseases also accounted for the greatest proportion of excess PYLL in the Netherlands.[64]

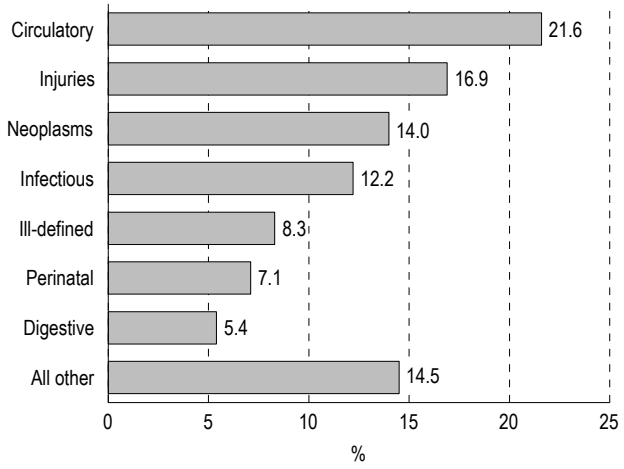
If all income quintiles had experienced the mortality rates of the richest quintile, and the same rates of excess deaths also applied to rural and small town Canada, then 13,000 fewer males and 5,000 fewer females would have died before age 75 in 1996 (Table 8 - notes). From 1971 to 1996, the rate of excess PYLL before age 75 per thousand population declined by 35% (from nearly 2000 in 1971 to about

Chart 9
Total potential years of life lost (PYLL) (0-74) by cause of death (International Classification of Diseases chapters) and income-related excess PYLL (0-74), urban Canada, 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
***Note:** Excess PYLL is defined as the difference between observed and expected PYLL, where expected PYLL is that which would have occurred if the age- and sex-specific mortality rates in the richest quintile had applied to the total population.*

Chart 10
Income-related excess potential years of life lost (PYLL) by cause of death (International Classification of Diseases chapters), urban Canada, 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
***Note:** Excess PYLL is defined as the difference between observed and expected PYLL, where expected PYLL is that which would have occurred if the age- and sex-specific mortality rates in the richest quintile had applied to the total population.*

Table 8
Income-related excess deaths and excess potential years of life lost (PYLL) before age 75, by sex, all causes of death together, urban Canada, 1971 to 1996

	Deaths			PYLL			Non-institutional population ('000)	Rates†	
	Total	Excess	% excess	Total	Excess	% excess		Excess deaths	Excess PYLL
Total									
1971	46,513	8,290	17.8	1,000,318	221,378	22.1	11,262	73.6	1,966
1986	51,983	9,951	19.1	918,510	188,981	20.6	14,446	68.9	1,308
1991	52,040	11,144	21.4	906,347	202,768	22.4	15,879	70.2	1,277
1996	53,588	10,775	20.1	903,702	216,442	24.0	16,953	63.6	1,277
Males									
1971	29,450	6,001	20.4	633,329	149,182	23.6	5,596	107.2	2,666
1986	32,401	7,520	23.2	585,242	142,965	24.4	7,129	105.5	2,005
1991	32,374	8,249	25.5	580,228	149,372	25.7	7,857	105.0	1,901
1996	32,920	7,740	23.5	568,320	154,282	27.1	8,373	92.4	1,843
Females									
1971	17,063	2,289	13.4	366,990	72,196	19.7	5,665	40.4	1,274
1986	19,582	2,431	12.4	333,269	46,016	13.8	7,316	33.2	629
1991	19,666	2,896	14.7	326,119	53,396	16.4	8,022	36.1	666
1996	20,668	3,035	14.7	335,383	62,161	18.5	8,581	35.4	724

***Data sources:** Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
***Notes:** If the same rate of excess premature deaths also applied to rural and small town Canada, there would have been almost 18,000 excess premature deaths in the non-institutional population for all of Canada in 1996 (13,000 males and 5,000 females).*
† Excess deaths and excess PYLL before age 75 per 100,000 non-institutional population aged 0 to 74.

Other studies on socio-economic differentials in circulatory diseases

In addition to the large socio-economic differentials for ischemic heart disease found in this study, an earlier Canadian study found similar but less striking differential mortality by income for stroke.[28, 31] Another study showed that differentials in health care after acute myocardial infarction (heart attack) in Canada were not responsible for most of the differences in survival across socio-economic categories.[65] Similar results were also found with respect to socio-economic differentials in treatment and survival after stroke.[23] Thus, for both heart attack and stroke in Canada, socio-economic differentials in mortality rates appear to be due primarily to differences in incidence rather than differences in treatment and survival.

In Scotland, socio-economic deprivation was found to have a profound effect on the risk of having a first heart attack, the chance of reaching hospital alive, and the probability of surviving the first month.[66] This study concluded that reducing mortality from heart disease requires a focus on primary prevention that explicitly addresses socio-economic inequalities.

In Finland, about half the excess mortality among men in lower social classes and a smaller proportion among women was found to be associated with their more adverse cardiovascular risk profile, so improvements in health behaviours would be helpful (though not sufficient) in reducing death rates.[67] Furthermore, the study concluded that health inequalities would have to be dealt with at multiple levels, including general social policy.

In the United States, living in a disadvantaged neighbourhood was associated with a greater incidence of coronary artery disease, even after adjustment for established risk factors.[68]

For occupation-based social classes in Australia, rate differences (but not rate ratios) in deaths due to coronary artery disease declined from the late 1970s to the mid-1990s,[47] paralleling the trends observed in this study.

In a 12-year follow-up study of middle-aged Swedish men, age-adjusted odds ratios by occupational classes were of about the same magnitude for death from coronary artery disease as for all-cause mortality,[69] similar to what was found for ASMR rate ratios for Canada. After further adjustment for 11 other risk factors, the odds ratios were reduced by 25% for all-cause mortality and by 30% for death due to coronary artery disease. For Swedish women, exposure to socio-economic disadvantage in both early and later life was associated with substantially increased risk of coronary artery disease, even after adjustment for marital status and traditional risk factors for heart disease.[70]

Thus, the differentials found for Canada appear to be reasonable estimates of what might have been found with individual-level methods and longitudinal study designs and are not simply due to differences in risk factors across the quintiles.

Although risk factors clearly do not account for all of the socio-economic differentials observed, they undoubtedly contribute substantially to death due to cardiovascular disease and other causes of death in Canada. The risk of coronary artery disease in Ontario was about twice as high among people with less education, largely because of a higher prevalence of smoking and elevated cholesterol.[71]

Marked socio-economic differentials were also apparent in the prevalence of smoking, sedentary living, and overweight in Canada, and there was little progress from 1985 to 1991 in narrowing those differentials.[72] Except for higher alcohol intake among richer people, all measures of unhealthy behaviours were inversely associated with various measures of socio-economic status (education, occupation, source of income, and income).[73] In addition, there were substantial socio-economic differentials in the prevalence of food insecurity in Canadian households, with poorer households at much higher risk.[74]

In a 10-year mortality follow-up study from the Nutrition Canada Survey of the early 1970s, important risk factors for death, as well as all-cause mortality in adults, were associated with indicators of lower socio-economic status.[10]

Based on mortality and disability across two waves of Canada's National Population Health Survey,[24] there were also substantial differences in disability-free life expectancy by income and education, as well as by behavioural risk factors such as smoking, physical activity, and abnormal body mass index. The socio-economic differentials were reduced but not eliminated by control for the behavioural risk factors.

1300 in 1996), almost all of that decline occurring by 1986. The trends for excess PYLL were not the same as those for differences in the probability of survival to age 75, since delaying a death from age 25 to age 50 results in a saving of 25 years of potential life (for PYLL), but no change in the probability of survival to age 75.

In 1971, 39% of the excess PYLL was accounted for by deaths among children aged less than 15 (data not shown). By 1996, deaths at younger ages had declined to such an extent that only 12% of excess PYLL was accounted for by that age group. The changing socioeconomic differentials in mortality by certain causes of death and possible reasons for those changes are discussed below.

Causes of death showing progress toward "Health for All"

For several causes of death—including ischemic heart disease, most injuries, liver cirrhosis, uterine cancer and perinatal conditions—age-standardized mortality rates declined over the 25-year study period and differences among income quintiles narrowed (Chart 11, plus upper panels of Table 9).

The mortality rate ratios for ischemic heart disease were only moderate, but the rate differences—although considerably narrowed since 1971—remained huge. Rates declined considerably more for males than for females, and rates for the poorest males declined the most (Chart 11A). Nevertheless, the heart disease mortality gradient in 1996 was evenly stepped from richest to poorest, and the differences between successive quintiles were still very large in absolute terms. The differences for females were smaller than those for males, but still substantial (Chart 11B), with successively higher rates in poorer quintiles.

For injuries except motor vehicle crashes and suicide (Chart 11C)—that is, for falls, poisoning, drowning, fires, and so forth—mortality rates and differences by income narrowed considerably over time, but the poorest quintile continued to be at a relatively greater disadvantage.

For all external causes of death (that is to say, for all accidents, poisoning and violence), mortality rates and differences by income also diminished markedly over time (data not shown). As was previously noted for the reduction of all injury-related deaths among children,[35] the explanation for this success probably relates to many factors beyond the health care system, including legislative, regulatory, policy, educational, product-safety, transportation-safety, school and occupational health and safety, public health, and other improvements over time. Although it was not possible to apportion the declines in mortality rates that were due to specific interventions, the reduction in deaths due to motor vehicle crashes, for example, was probably related to changes in the design and use of seatbelts, infant seats, and air bags, improvements in tires and brakes, vehicle safety design, and helmets for bicyclists, as well as increased school busing, improved emergency treatment of trauma, and stricter enforcement of laws against speeding and drunk driving. Analogous regulatory, policy, educational, emergency treatment, and product-safety improvements also apply to the prevention of deaths due to drowning, fire, and poisoning.

For liver cirrhosis among males (Chart 11D), great progress was achieved, particularly for the poorest quintile, but the differences remained substantial. For liver cirrhosis among females (Chart 11E), income differentials in mortality rates appear to have been eliminated.

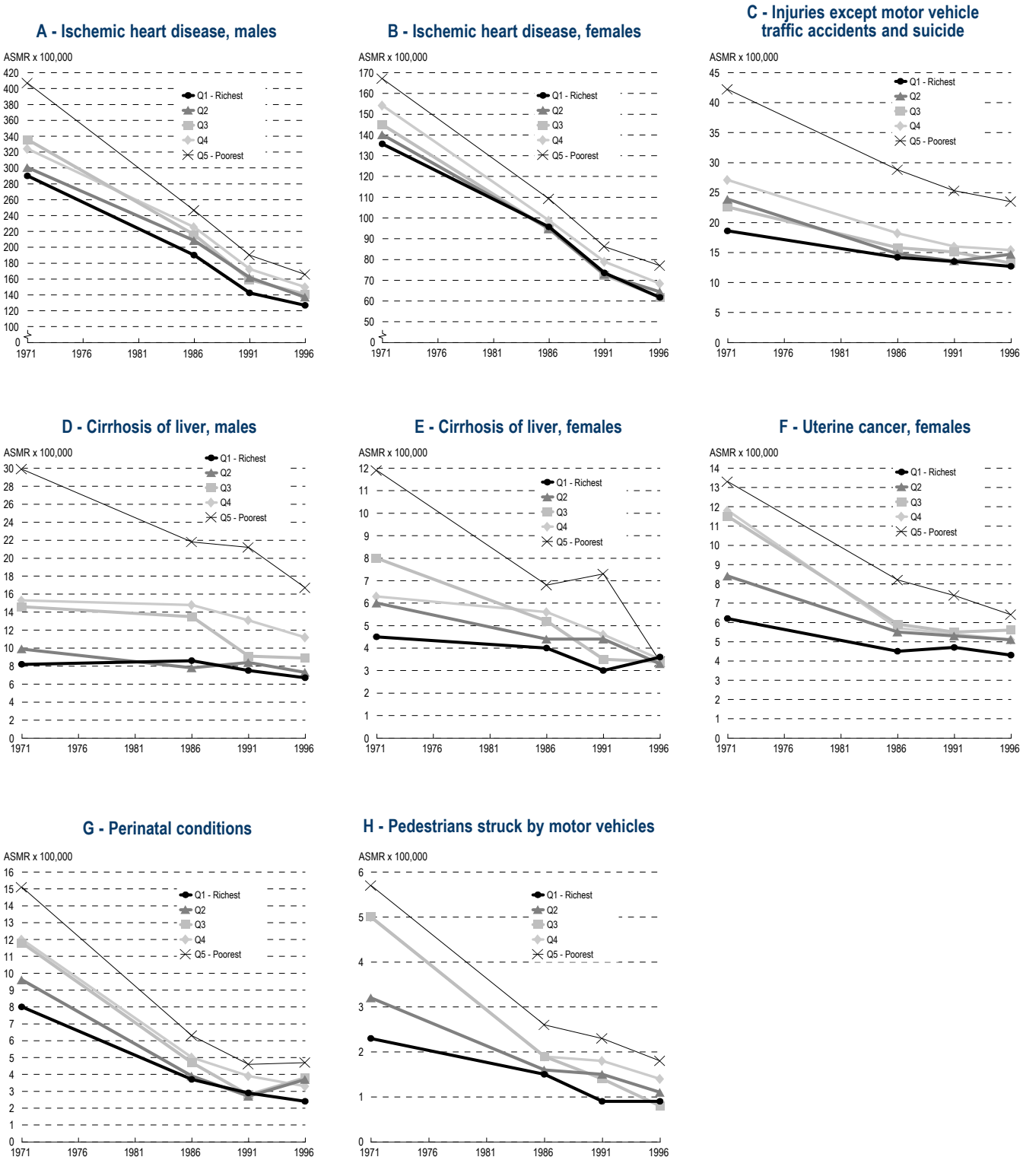
Income differentials in mortality rates also declined for deaths caused by uterine (including cervical) cancer (Chart 11F). The most rapid reductions were achieved among the poorest quintiles, within which the rates were highest throughout the 25-year period. Nevertheless, the remaining socio-economic differentials in uterine cancer mortality are still important, and the overall rates in Canada are relatively high compared with the best international standards. Cervical cancer screening in Canada was less common among older and single women, as well as among women with lower education, non-English language, or birth outside of Canada, and among those with negative health and lifestyle characteristics, so there remains considerable scope for improvement in avoiding unnecessary death through early detection.[75]

The trends for perinatal conditions (Chart 11G) resembled those reported for all infant deaths. ASMRs declined rapidly in all quintiles, but the gains were most rapid in the poorer quintiles, so the inter-quintile rate difference diminished from 7.1 in 1971 to 2.3 in 1996. With respect to socio-economic differentials in perinatal and all infant mortality rates, a thorough review of the best available evidence examined many years of census-linked medical birth registry data for the Nordic countries:[76] this review showed that although behavioural and socio-demographic risk factors are important explanatory variables for feto-infant mortality, so are socio-economic status variables such as maternal education and income. For Canada, low maternal education was strongly associated with excess fetal and infant mortality in Quebec, largely because of excess deaths due to perinatal conditions and sudden infant death syndrome.[20]

Death rates for pedestrians struck by motor vehicles (Chart 11H) declined rapidly and income differences for this cause of death diminished.

Chart 11

Causes of death showing progress toward "Health for All": age-standardized mortality rates, by neighbourhood income quintile, urban Canada, 1971 to 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

Table 9

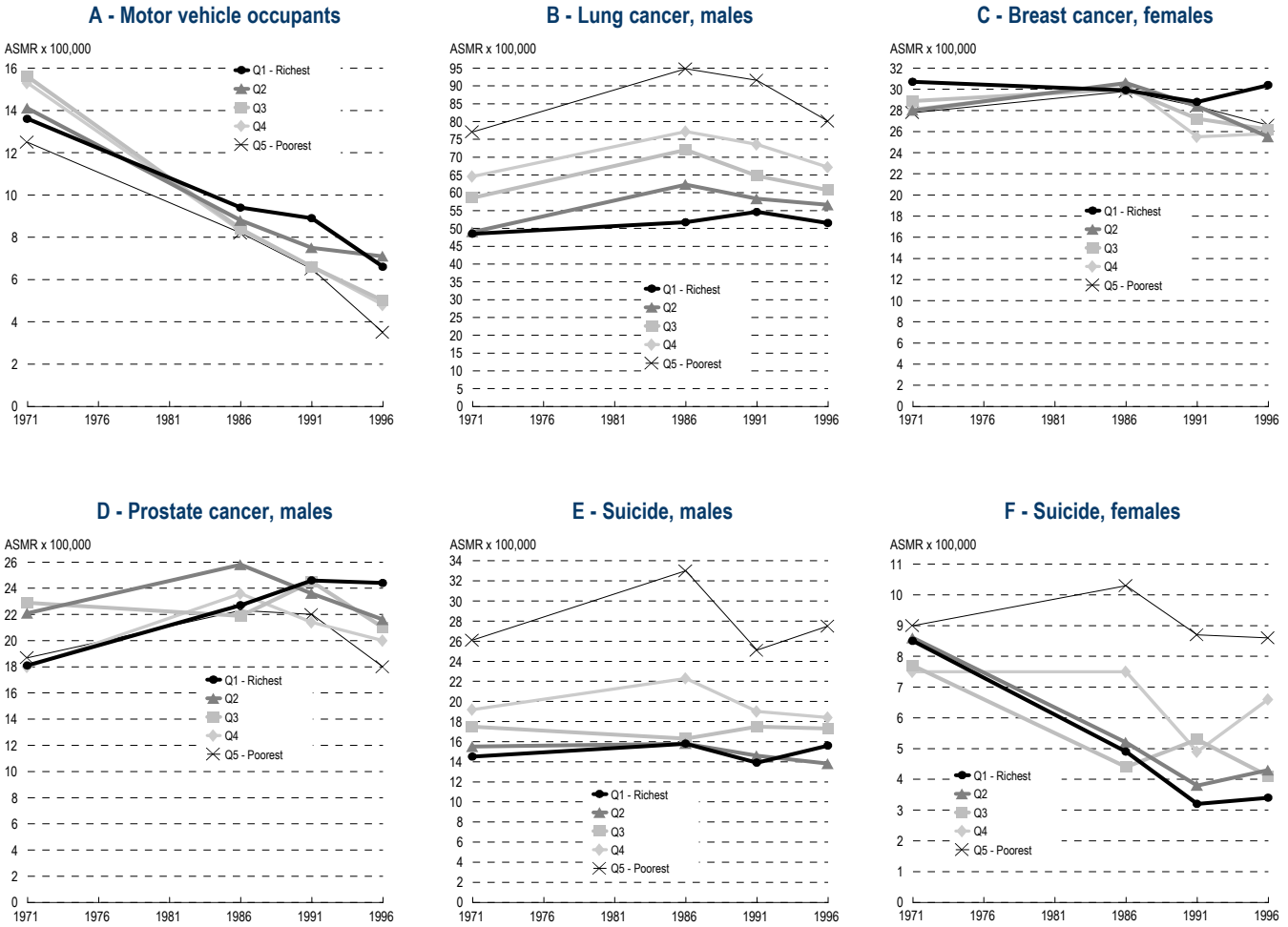
Age-standardized mortality rates per 100,000 population, all ages, for selected causes of death, by sex and neighbourhood income quintile, urban Canada, 1971 to 1996

	Total	Q1	Q2	Q3	Q4	Q5	RR†	RD‡	Excess§	% excess††
All causes‡‡										
Both sexes										
1971	712.8	615.9	641.9	701.9	710.6	847.1	1.38	231.2	96.9	13.6
1986	589.7	526.9	547.5	566.1	595.8	702.9	1.33	175.9	62.8	10.6
1991	526.3	468.3	492.6	497.3	541.9	630.5	1.35	162.2	58.0	11.0
1996	502.0	450.0	472.8	474.6	505.1	593.1	1.32	143.1	51.9	10.3
Males										
1971	961.7	801.4	849.3	936.1	942.5	1,186.9	1.48	385.5	160.2	16.7
1986	792.4	675.3	713.3	752.9	808.9	983.9	1.46	308.7	117.1	14.8
1991	706.7	588.1	645.9	669.3	735.5	880.4	1.50	292.3	118.6	16.8
1996	663.9	567.9	608.5	630.6	672.8	813.5	1.43	245.6	96.0	14.5
Females										
1971	523.1	474.4	483.2	524.7	533.2	584.8	1.23	110.3	48.7	9.3
1986	440.0	420.9	426.1	428.0	437.3	489.1	1.16	68.1	19.1	4.3
1991	394.4	380.8	384.6	372.3	399.2	440.9	1.16	60.1	13.7	3.5
1996	385.2	367.2	376.6	363.0	383.7	427.7	1.16	60.5	18.0	4.7
Ischemic heart disease										
Males										
1971	338.3	289.9	300.4	335.6	324.0	406.8	1.40	116.9	48.4	14.3
1986	217.8	190.1	208.4	215.7	225.2	246.4	1.30	56.3	27.7	12.7
1991	165.7	142.5	161.7	159.1	172.4	190.1	1.33	47.6	23.2	14.0
1996	145.3	126.8	137.0	140.6	149.7	165.7	1.31	38.8	18.5	12.7
Females										
1971	150.2	135.7	140.1	144.9	154.2	167.1	1.23	31.4	14.5	9.7
1986	99.0	95.7	94.8	94.6	98.7	109.2	1.14	13.5	3.3	3.3
1991	76.9	73.5	72.8	72.4	78.9	86.2	1.17	12.7	3.4	4.4
1996	67.3	61.7	64.4	61.8	68.3	77.0	1.25	15.3	5.6	8.3
Injuries except motor vehicle traffic accidents and suicide										
Both sexes										
1971	27.1	18.6	23.9	22.6	27.1	42.2	2.27	23.6	8.5	31.5
1986	18.4	14.2	14.8	15.8	18.2	28.8	2.03	14.6	4.2	22.7
1991	16.6	13.5	13.6	15.1	16.0	25.3	1.88	11.8	3.1	18.7
1996	16.0	12.7	14.7	13.2	15.4	23.5	1.85	10.8	3.3	20.8
Cirrhosis of liver										
Males										
1971	16.2	8.2	9.9	14.6	15.3	29.9	3.66	21.7	8.1	49.7
1986	13.4	8.6	7.8	13.5	14.8	21.8	2.55	13.3	4.9	36.2
1991	11.9	7.5	8.4	9.1	13.1	21.2	2.85	13.8	4.4	37.2
1996	10.2	6.7	7.3	8.9	11.2	16.7	2.50	10.0	3.5	34.2
Females										
1971	7.5	4.5	6.0	8.0	6.3	11.9	2.66	7.4	3.0	40.1
1986	5.3	4.0	4.4	5.2	5.6	6.8	1.67	2.7	1.2	23.1
1991	4.6	3.0	4.4	3.5	4.6	7.3	2.42	4.3	1.6	34.3
1996	3.4	3.6	3.3	3.4	3.5	3.4	0.95	-0.2	-0.2	-5.6
Uterine cancer										
Females										
1971	10.4	6.2	8.4	11.5	11.8	13.3	2.16	7.1	4.2	40.6
1986	6.0	4.5	5.5	5.9	5.7	8.2	1.82	3.7	1.5	24.6
1991	5.7	4.7	5.3	5.5	5.4	7.4	1.58	2.7	1.0	17.9
1996	5.3	4.3	5.1	5.6	5.1	6.4	1.50	2.1	1.1	20.2
Perinatal conditions										
Both sexes										
1971	11.4	8.0	9.6	11.8	12.0	15.1	1.90	7.1	3.4	30.1
1986	4.7	3.7	3.9	4.7	5.0	6.3	1.70	2.6	1.0	21.4
1991	3.4	2.9	2.7	2.8	3.9	4.6	1.57	1.7	0.5	13.4
1996	3.6	2.4	3.7	3.8	3.3	4.7	1.94	2.3	1.2	33.6
Pedestrians in motor vehicle traffic accidents										
Both sexes										
1971	4.4	2.3	3.2	5.0	5.0	5.7	2.45	3.4	2.0	46.7
1986	1.9	1.5	1.6	1.9	1.9	2.6	1.78	1.2	0.4	22.9
1991	1.6	0.9	1.5	1.4	1.8	2.3	2.44	1.4	0.7	42.1
1996	1.2	0.9	1.1	0.8	1.4	1.8	2.13	1.0	0.4	31.5
Motor vehicle occupants										
Both sexes										
1971	14.1	13.6	14.1	15.6	15.3	12.5	0.92	-1.1	0.5	3.7
1986	8.6	9.4	8.8	8.4	8.3	8.2	0.87	-1.2	-0.9	-10.1
1991	7.1	8.9	7.5	6.6	6.6	6.5	0.74	-2.3	-1.7	-24.5
1996	5.4	6.6	7.1	5.0	4.8	3.5	0.53	-3.1	-1.2	-22.3

	Total	Q1	Q2	Q3	Q4	Q5	RR†	RD‡	Excess§	% excess††
Lung cancer										
Males										
1971	61.4	48.5	49.0	58.6	64.6	77.1	1.59	28.6	12.9	21.0
1986	73.0	51.7	62.3	72.0	77.2	94.8	1.83	43.0	21.2	29.1
1991	69.2	54.6	58.3	64.8	73.6	91.6	1.68	37.0	14.5	21.0
1996	63.6	51.5	56.6	60.7	67.2	80.1	1.56	28.6	12.1	19.1
Breast cancer										
Females										
1971	28.5	30.7	28.0	28.9	28.1	27.8	0.90	-3.0	-2.2	-7.7
1986	30.2	29.9	30.6	30.0	30.5	29.8	1.00	-0.1	0.3	0.9
1991	27.7	28.8	28.4	27.2	25.5	28.4	0.99	-0.3	-1.0	-3.8
1996	26.7	30.4	25.5	26.2	25.8	26.6	0.88	-3.8	-3.7	-13.8
Prostate cancer										
Males										
1971	19.8	18.1	22.1	22.9	18.0	18.7	1.03	0.6	1.7	8.7
1986	23.1	22.7	25.8	21.9	23.6	22.3	0.99	-0.3	0.5	2.0
1991	23.1	24.6	23.6	24.5	21.4	22.0	0.90	-2.5	-1.5	-6.6
1996	20.9	24.4	21.6	21.0	20.0	18.0	0.74	-6.4	-3.5	-16.5
Suicide										
Males										
1971	18.8	14.5	15.5	17.5	19.2	26.1	1.80	11.6	4.3	22.8
1986	20.8	15.8	15.8	16.3	22.3	33.0	2.10	17.3	5.0	24.2
1991	18.1	13.9	14.6	17.5	19.0	25.1	1.81	11.2	4.2	23.4
1996	18.7	15.6	13.8	17.3	18.4	27.5	1.76	11.9	3.2	16.9
Females										
1971	8.2	8.5	8.6	7.7	7.5	9.0	1.06	0.5	-0.3	-3.2
1986	6.4	4.9	5.2	4.4	7.5	10.3	2.11	5.4	1.5	23.7
1991	5.2	3.2	3.8	5.3	4.9	8.7	2.75	5.5	2.1	39.3
1996	5.5	3.4	4.3	4.1	6.6	8.6	2.53	5.2	2.1	38.4
Lung cancer										
Females										
1971	8.8	7.7	8.5	6.8	10.3	10.1	1.32	2.5	1.1	12.7
1986	23.1	18.7	21.6	21.8	23.7	28.0	1.49	9.2	4.3	18.8
1991	27.8	25.6	25.6	26.9	27.8	32.6	1.27	7.0	2.2	7.9
1996	30.7	27.0	30.0	30.4	30.5	34.8	1.29	7.8	3.7	12.0
Infectious diseases										
Both sexes										
1971	4.6	3.4	2.9	3.9	4.5	7.6	2.25	4.2	1.3	27.2
1986	5.8	3.9	3.6	4.7	6.4	10.1	2.58	6.2	1.9	32.6
1991	10.2	5.1	6.4	8.0	11.3	20.4	3.99	15.3	5.0	49.5
1996	10.5	6.0	7.5	7.6	11.0	20.5	3.41	14.5	4.5	42.7
Ill-defined conditions										
Both sexes										
1971	4.4	2.6	3.7	3.6	4.1	6.9	2.62	4.3	1.8	40.5
1986	8.0	5.3	5.0	7.0	8.0	13.8	2.60	8.5	2.7	33.6
1991	11.5	8.1	8.4	10.0	12.3	18.3	2.27	10.3	3.4	29.6
1996	10.0	6.7	7.3	8.2	10.6	17.0	2.52	10.2	3.3	32.8
Mental disorders										
Both sexes										
1971	2.7	1.6	1.8	2.1	1.8	5.9	3.74	4.3	1.2	42.2
1986	5.9	4.3	4.9	4.6	5.2	10.1	2.35	5.8	1.6	27.2
1991	6.1	5.6	5.4	5.2	5.9	9.0	1.62	3.5	0.6	9.6
1996	8.2	7.7	7.5	7.1	8.8	10.1	1.30	2.3	0.5	6.2
Diabetes										
Males										
1971	15.5	15.0	13.4	15.7	15.6	17.1	1.14	2.1	0.5	3.0
1986	13.0	10.5	14.3	12.5	13.1	14.6	1.39	4.1	2.4	18.8
1991	13.7	11.3	11.5	12.2	14.5	18.8	1.67	7.5	2.5	17.9
1996	16.1	13.5	13.5	14.5	16.8	21.2	1.56	7.6	2.6	16.1
Females										
1971	13.3	10.5	10.1	13.4	13.3	17.2	1.64	6.7	2.8	20.9
1986	9.2	8.0	8.8	9.3	9.7	10.1	1.26	2.1	1.2	12.5
1991	9.2	9.1	8.2	8.6	9.8	10.6	1.17	1.6	0.2	1.7
1996	9.9	9.1	7.8	9.5	8.9	13.4	1.47	4.3	0.7	7.6

Data sources: *Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
Notes: *Causes are shown in the order they appear in Charts 11, 12 and 13. See Appendix Table A for International Classification of Diseases codes corresponding to each cause. See Appendix Table C for standard errors.*
† Inter-quintile rate ratio (Q5/Q1).
‡ Inter-quintile rate difference (Q5 - Q1).
§ Population-attributable risk (Total - Q1).
†† Population-attributable risk percentage [100 × (Total - Q1)/Total].
‡‡ Includes causes for which detailed data are not shown.

Chart 12
Causes of death with little change, mixed results, or inverted gradients: age-standardized mortality rates, by neighbourhood income quintile, urban Canada, 1971 to 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*

Causes of death with little change, mixed results, or inverted gradients

A few causes of death showed little change or mixed results, or the gradients by income were reversed from the usual pattern. These causes included deaths to motor vehicle occupants of both sexes, lung cancer, prostate cancer and suicide for males, and breast cancer for females (Chart 12, plus middle panels of Table 9).

For deaths to vehicle occupants of both sexes involved in traffic accidents (Chart 12A), the gradient by income was inverted, with the lowest rates in the poorest quintiles and higher rates in richer quintiles. This may be due in part to differential exposure to risk, as residents of poorer quintiles may travel fewer vehicle-kilometres.

For lung cancer among males (Chart 12B), there was little net change from 1971 to 1996 in either income-related disparities or mortality rates. However, both rates and rate differences peaked in 1986.

For female breast cancer (Chart 12C), the mortality gradient by income was also inverted, with the richest quintile having somewhat higher rates than the other quintiles. Another study found that the multivariate-adjusted risk for having (as opposed to dying from) post-menopausal breast cancer in Canada was 1.3 for high versus low income adequacy and 1.4 for high versus low educational attainment.[77] Control variables included various factors that differ by socio-economic status, such as age at menarche, age at first pregnancy, number of live births, months of breastfeeding, and maternal height. These findings

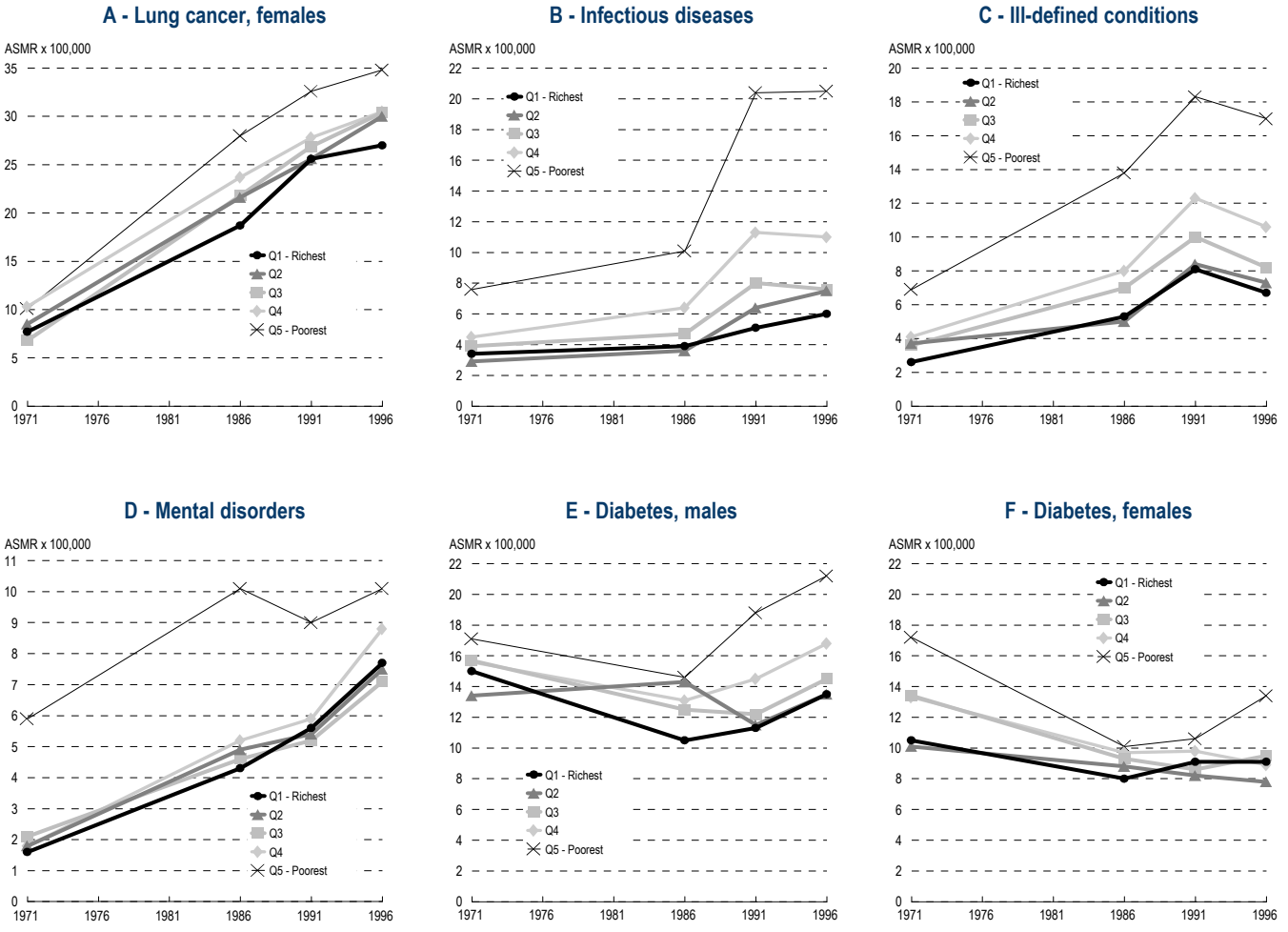
suggest that in the case of breast cancer, socio-economic differentials in risk factors may be protective for women of lower socio-economic status.

For prostate cancer (Chart 12D), the mortality rate for males in the richest quintile increased from among the lowest in 1971 to clearly the highest in 1996. By that time a clear inverse gradient was evident. However, the modest decline in mortality rates for prostate cancer in Canada during the early 1990s was probably not the result of increased screening.[78]

With the exception of uterine cancer, for which reductions in mortality rates and socio-economic disparities have been impressive, relatively little progress toward the goal of "Health for All"[1, 79] has been achieved in Canada with respect to most of the other cancer causes of death. However, an international comparison of cancer survival in Toronto and Detroit found that cancer incidence rates were similar in the two cities, but post-incidence mortality rates were lower in Toronto than in Detroit, especially for the poorest areas. These findings suggest that treatment outcomes were not strongly related to income in Canada, contrary to what was found for the United States.[80]

There was little net change in the pattern of suicide rates for males (Chart 12E), in terms of either levels or disparities. However, suicide rates for women (Chart 12F) generally decreased, except within the poorest quintile. High suicide mortality rates, especially among males, represent a continuing problem in Canada. As

Chart 13
Causes of death with increased mortality rates and wider disparities by income: age-standardized mortality rates, by neighbourhood income quintile, urban Canada, 1971 to 1996



***Data sources**: Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
***Note:** Infectious diseases include 1986 AIDS recoded from metabolic to infectious diseases.*

mortality rates for other causes decline, the relative importance of such currently intractable causes of death increases and constitutes a larger portion of the overall burden of excess mortality related to socio-economic disparities.

Causes of death with increased mortality rates and wider disparities by income

For a few causes of death, mortality rates increased while disparities by income widened. These causes included lung cancer for females, as well as infectious diseases, ill-defined conditions, mental disorders, and diabetes for both sexes (Chart 13, plus lower panels of Table 9).

Mortality rates for lung cancer increased rapidly for females of all income quintiles (Chart 13A), and the gap between rich and poor widened. From 1986 onward, the rates in the poorest quintile were substantially higher than those of the other quintiles (see *Differential vulnerability to lung cancer among smokers …*).

Partly because of AIDS, mortality rates due to infectious diseases (Chart 13B) increased substantially, particularly from 1986 to 1996, and the gradient by income became much steeper. Follow-up studies in Vancouver showed that after HIV infection (the cause of AIDS), low-income men had shorter survival,[86] while higher-income men experienced slower disease progression, despite receiving the same treatment.[87] In both Vancouver and Toronto, tuberculosis cases were approximately 4 times more frequent in the lowest than in the highest neighbourhood income decile.[88] Among immigrants to Ontario, the risk of developing tuberculosis after coming to Canada was higher for persons coming from countries where the disease is endemic, but even after adjustment for country of origin and other risk factors, low educational attainment was associated with higher risk.[89] In the United States, neighbourhood socio-economic status accounted for much of the increased risk of tuberculosis that had previously been attributed to race and ethnicity.[90]

Differential vulnerability to lung cancer among smokers, and effects of environmental tobacco smoke

Wide socio-economic disparities in lung cancer mortality are a continuing problem among men and a rapidly growing problem among women in Canada. While the most obvious causes are certainly the increased prevalence of smoking among women—particularly those of lower socio-economic status—and the previously high rates of smoking among men, several studies in the international literature have found that the sharp socio-economic disparities in lung cancer incidence and mortality cannot be fully explained by differential prevalence of one's own smoking across socio-economic groups. From 17 years of mortality follow-up in the Copenhagen study, it was found that even among smokers, lung cancer incidence rates were 3 times higher among lower-class than upper-class males.[81] Differences in vulnerability to lung cancer were said to be the most likely explanation for the differences, since only about 20% of the excess risk could be explained by differences in smoking among the social classes. Two Scottish cohort studies also concluded that there was a difference in lung cancer risk between social classes, in addition to the effect of smoking, and that this difference in risk could be attributed to poor lung health, deprivation, and poor socio-economic conditions throughout life.[82] Among Finnish males aged 50 to 69 with full smoking history and 7 years of mortality follow-up, lung cancer mortality among less-educated men who smoked heavily was about a third higher than that of their better-educated counterparts, and the excess risk remained practically unchanged after additional adjustment for inhalation and duration of smoking and partial adjustment for occupational exposures.[83]

However, in addition to differentials in the prevalence of smoking by various measures of socio-economic status, both residential and occupational exposure to second-hand smoke may also be associated with greater risk of lung cancer in never-smoking Canadian women.[84] In fact, according to a study in the early 1990s, about half of the greater incidence of lung cancer among non-smoking women with 9 or fewer years of education than among all other women was apparently related in part to higher lifetime exposures to second-hand smoke at home and in the workplace. Another recent Canadian case–control study found that, compared with the highest-income group, the adjusted relative risks of lung cancer were 1.5 and 1.7 for low-income men and women, respectively.[85] Similar differentials in risk were found with respect to low versus high education. These findings strongly suggest that the mortality rate ratios by neighbourhood income reported here yielded a reasonable, if conservative, estimate of the excess risk associated with individual-level indicators of socio-economic status, and that the excess risks for the groups with low socio-economic status were not simply due to differences in behavioural risk factors such as their own smoking.

For ill-defined conditions (Chart 13C), mortality rates increased and disparities among the quintiles widened. These changes may reflect the secular decline in the proportion of deaths subject to autopsy (vital statistics autopsy data, not shown). Had specific causes of death been coded for those deaths, the extent of socio-economic disparities for other causes of death would have been somewhat greater. However, because most of the deaths coded to ill-defined conditions were likely due to major causes of death such as cardiovascular diseases or cancer, it is unlikely that the trends in socio-economic disparities for any specific cause of death would have been unduly influenced by the existing coding.

Rates of death due to mental disorders (Chart 13D) increased rapidly, and the poorest quintile retained relatively higher rates. Alcoholism was included in this category but was not responsible for the increases (data not shown).

For diabetes among males (Chart 13E), mortality rates for most quintiles decreased from 1971 to 1986, but then increased from 1986 to 1996. Because the increases in the latter period were especially large for the poorest quintiles, the inter-quintile rate differences widened from 1986 to 1996. For diabetes among females (Chart 13F), mortality rates for all quintiles declined from 1971 to 1986 and then changed little from 1986 to 1996, except for the poorest quintile, in which rates increased rapidly. Therefore, the inter-quintile rate difference was considerably greater in 1996 than it had been in 1986. The trends with respect to the overall rates and socio-economic disparities in diabetes mortality are disquieting and deserve further study. Possible relationships to trends in obesity and sedentary lifestyles should be examined, as well as differences by ethnic origin and place of birth.[91]

Timing of changes in mortality rates

The timing of the changes in mortality rates varied by cause of death. For some causes, most progress occurred in the 1971–1986 period, immediately after the introduction of universal medicare in Canada. For others, progress continued fairly steadily throughout the entire 25-year study period or even accelerated during the last decade (1986 to 1996). For a few causes, the situation deteriorated over the last decade, notably during the 5 years from 1991 to 1996, a period of increasing unemployment and higher prevalence and intensity of low income in urban Canada,[94,95] as well as of increased wealth inequality.[96] Nevertheless, for Canada as a whole from 1985 to 1995, after including the effects of government income taxes and transfers, families' disposable incomes became more equal.[97]

Income or other factors?

Although the quintiles for this study were based on CTs ranked by a measure of income adequacy, they also differed systematically with respect to sources of income, tenancy status, education, occupation, unemployment, and period of immigration, among other socio-economic factors. Thus, the strong relationships between mortality and income that were observed do not necessarily mean that income, rather than one or more of the other characteristics, was the causal factor. It is not just a question of determining which characteristic was most closely related to mortality or of statistically "controlling" for the other factors. Rather, various socio-economic factors tend to be determined during and act at different periods of a person's life. Hence educational attainment—typically reached by the mid-20s—qualifies a person for an occupation, which in turn produces a flow of income throughout the person's economically active life and after retirement. Effects related to income may thus be determined to a greater or lesser extent by education or occupation, rather than by income itself. Conversely, income may affect health beyond other closely related socio-economic factors such as education and occupation.[98-99] Furthermore, effects related to neighbourhood differences are not necessarily the same as effects at the individual or family level. (For further critical comments on various other aspects of the study, see *Limitations*.) Longitudinal mortality data with individual-level information for various measures of socio-economic status are thus needed to help sort out the effects of each of these determinants and to provide more relevant information for health and social planning and policy analysis.

Concluding remarks

On the basis of small-area data for urban Canada from 1971 to 1996, socio-economic disparities in mortality appear to have diminished substantially over time, for both all-cause mortality and for most specific causes of death. Nonetheless, such differentials are still of major concern in Canada.

To be more directly relevant to policies intended to reduce socio-economic inequities in health outcomes, mortality data linked to individual- and family-level socio-economic characteristics (such as education, occupation, aboriginal origins, language, visible minority status, race or ethnicity, period of immigration, and activity limitation status) are clearly required. Given that such data are currently not available for most Canadian vital statistics registration data—nor are they likely to become available in the near future—

Limitations

Generalizability of the findings. This study was based on neighbourhood rather than individual or family income, and its findings apply only to the 60% of Canada's population who live in metropolitan areas. However, the results of other Canadian studies[8-22, 24] suggest that the pattern of disparity in mortality rates between socio-economic groups observed here is a reasonable, if somewhat conservative, reflection of what might be expected in an individual-level analysis. Furthermore, these studies indicate that the disparities are not limited to residents of census metropolitan areas (CMAs) nor to non-institutional residents. Indeed, follow-up studies based on individual-level income appear to show greater disparities by income, even after adjustment for initial health status and known risk factors, than do the analyses of the current study, which are based on group-level income measures.

Lower mortality of immigrants. The mortality rates of immigrants, especially recent immigrants, are lower than those of the Canadian-born population.[92] Since the foreign-born percentage of population was higher in poorer quintiles and this percentage increased in recent years, the expected effect would be a reduction in the visibility of the relationship between income and mortality, and that confounding effect should have increased over time, particularly in the period 1991 to 1996. For the 1986 data,[28] the inter-quintile difference in life expectancy at birth was 1.1 year greater for the Canadian-born population than for the entire non-institutional population of the CMAs.

Differential under-coverage of census. The differential impact of net census under-coverage by income was also estimated for 1986. A rough correction for net under-coverage reduced the inter-quintile difference in life expectancy at birth by about 0.5 year. Because of increasing net under-coverage in more recent censuses, it is likely that the effect of a correction would be somewhat greater for 1991 and 1996. In 1986 the combined effect of the two adjustments (restriction to people born in Canada and correction for differential net under-coverage) was to increase the inter-quintile disparity in life expectancy at birth by 0.6 year.

Crossover in mortality at advanced ages. The greatest disparity in mortality rate ratios occurred in infancy and during the prime working years. However, at ages 85 and older, rate ratios for females in the poorest quintile compared to the richest were less than 1.00, a crossover that has also been observed for elderly blacks in the United States.[93] This effect may be due partly to differential survival and partly to the exclusion of institutional residents, who account for about one-third of that age group. There may also be numerator–denominator bias because the methods used to exclude institutional residents from the population (based on the census classification of collective dwelling type) was different from the method used to exclude them from the deaths (based on provincially recognized lists of health-related facilities).

Changes over time. Caution is clearly advisable in interpreting changes over time based on neighbourhood income variables. For example, had the homes of the poor been dispersed much more equally throughout all neighbourhoods in 1996, rather than being concentrated in poorer neighbourhoods as they were in 1971 (and 1996), then the disparities between quintiles—as measured in this type of study—would have been smaller, even in the absence of changes in relative mortality rates at the individual level. However, for CTs within Canada's largest metropolitan areas, residential segregation by income appears to have become stronger rather than weaker from 1991 to 1996.[94]

Cost of living differentials across CMAs. By constructing the quintiles within each CMA before aggregating to the national level, we minimized the potential effect of inter-metropolitan differences in income, housing, and other living costs. CMA-based quintiles also revealed greater inter-quintile differences in life expectancy than did national quintiles (data not shown). In addition, if all CTs had been ranked nationally before the quintiles were constructed, 36% of the population of metropolitan Toronto would have been placed into the richest quintile in 1986, whereas 4 metropolitan areas in eastern Canada would have had no population in that quintile.

other approaches are called for. Among the various options, mortality follow-up for a large sample from a recent census appears to offer the most feasible and effective approach.[100-101] Most other highly industrialized countries, including the United States,[102-104] Great Britain,[105-107] France,[108-109] Italy,[110-111] Spain,[112] Denmark,[113-114] Norway,[38, 115] Sweden,[76, 116-119] Finland,[44-46] Lithuania,[120] Israel,[121-123] and New Zealand[124] have already produced such linked data. In Canada, census-linked mortality follow-up studies have so far been limited to particular occupations[125-126] or a single province.[13, 18] A national study of this kind would permit the wealth of socio-economic variables already collected through the census to be analyzed with respect to mortality for Canada as a whole.

Because socio-economic data for people living in institutions are not available from recent Canadian censuses, socio-economic differentials in mortality for

this segment of the population would still present a problem. Accoring to Statistics Canada Advisory Committee on Health Statistics,[127] the most straightforward solution would be to collect a limited amount of socio-economic data—similar to the few questions collected for the institutional samples in the Health and Activity Limitation Surveys—during future Canadian censuses.

Socio-economic differentials in health are not limited to mortality. When measures of disability or dependence are also taken into account, the disparities between socio-economic groups widen substantially.[17, 24, 128-132] Thus, future studies should evaluate socio-economic differentials not only for mortality, but also for more comprehensive measures of health expectancy.

Because of the multiple pathways through which such disparities are believed to arise, continued progress in reducing socio-economic disparities in mortality in Canada may require both broad-based intersectoral policies[133] and highly targeted interventions, as well as better data on the nature of the existing disparities with respect to socio-economic characteristics other than neighbourhood income.

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References

1 Health Canada. *Achieving Health for All: A Framework for Health Promotion* (Catalogue H39-102/1986E). Ottawa: Health Canada, 1986.

2 Mhatre SL, Deber RD. From equal access to health care to equitable access to health. *International Journal of Health Services* 1992; 22(4): 645-68.

3 Canadian Public Health Association. *Health Impacts of Social and Economic Conditions: Implications for Public Policy.* Ottawa: Canadian Public Health Association, 1997.

4 Liberatos P, Link BG, Kelsey JL. The measurement of social class in epidemiology. *Epidemiologic Reviews* 1988; 10: 87-121.

5 Marmot M, Feeney A. General explanations for social inequalities in health. *IARC Scientific Publications* 1997; (138): 207-28.

6 Adler NE, Ostrove JM. Socioeconomic status and health: What we know and what we don't. *Annals of the New York Academy of Science* 1999; 896: 3-15.

7 Gwatkin DR. Health inequalities and the health of the poor: What do we know? What can we do? *Bulletin of the World Health Organization* 2000; 78(1): 3-18.

8 Billette A, Hill GB. Risque relatif de mortalité masculine et les classes sociales au Canada 1974. *Union médicale du Canada* 1978; 107: 583-90.

9 Howe G, Lindsay JP. A follow-up study of a ten percent sample of the Canadian labor force. I. Cancer mortality in males, 1965-1973. *Journal of the National Cancer Institute* 1983; 70(1): 37-44.

10 Johansen H, Semenciw R, Morrison H, et al. Important risk factors for death in adults: a 10-year follow-up of the Nutrition Canada Survey Cohort. *Canadian Medical Association Journal* 1987; 136: 823-8.

11 Wigle DT, Arraiz G, Mao Y. Mortality follow-up study of the Canada Health Survey cohort. In: Carpenter M, Fair ME, editors. *Proceedings of the Record Linkage Seminar and Workshop, Canadian Epidemiology Research Conference, 1989*. Ottawa: Occupational and Environmental Health Research Section, Statistics Canada; 1990 March. p. 19-28.

12 Hirdes JP, Forbes WF. Estimates of the relative risks of mortality based on the Ontario longitudinal study of aging. *Canadian Journal on Aging* 1989; 8(3): 222-37.

13 Buck C. *A Study of Regional Differences in Perinatal and Infant Mortality in the Province of Ontario* (final report project 6606-2759-42; OEHRS Publication List 73). Ottawa: Statistics Canada, 1989.

14 Roos NP, Havens B. Predictors of successful aging: a twelve-year study of Manitoba elderly. *American Journal of Public Health* 1991; 81(1): 63-8.

15 Hirdes JP, Forbes WF. The importance of social relationships, socioeconomic status and health status with respect to mortality among healthy Ontario males. *Journal of Clinical Epidemiology* 1992; 45(2): 175-82.

16 Wolfson M, Rowe G, Gentleman JF, Tomiak, M. Career earnings and death: a longitudinal analysis of older Canadian men. *Journal of Gerontology* 1993; 48(4): S167-79.

17 Nault F, Roberge R, Berthelot JM. Espérance de vie et espérance de vie en santé selon le sexe, l'état matrimonial et le statut socio-économique au Canada. *Cahiers québécois de démographie* 1996; 25(2): 241-59.

18 Mustard CA, Derksen S, Berthelot JM, et al. Age-specific education and income gradients in morbidity and mortality in a Canadian province. *Social Science and Medicine* 1997; 45(3): 383-97.

19 Chen J, Beavon D, Wilkins R. Mortality of retired public servants in Canada. *1996 Proceedings of the Social Statistics Section, American Statistical Association*. Alexandria, Virginia: American Statistical Association, 1997: 86-91.

20 Chen J, Fair M, Wilkins R, Cyr M, and Fetal and Infant Mortality Study Group of the Canadian Perinatal Surveillance System. Maternal education and fetal and infant mortality in Quebec. *Health Reports* (Statistics Canada, Catalogue 82-003) 1998: 10(2): 53-64.

21 Mustard CA, Derksen S, Berthelot JM, Wolfson M. Assessing ecologic proxies for household income: a comparison of household and neighbourhood level income measures in the study of population health status. *Health and Place* 1999; 5: 157-71.

22 Veugelers PJ, Yip AM, Kephart G. Proximate and contextual socioeconomic determinants of mortality: multilevel approaches in a setting with universal health care coverage. *American Journal of Epidemiology* 2001; 154(8): 725-32.

23 Kapral MK, Wang H, Mamdani M, Tu JV. Effects of socioeconomic status on treatment and mortality after stroke. *Stroke* 2002; 33: 268-75.

24 Bélanger A, Martel L, Berthelot JM, Wilkins R. Gender differences in disability-free life expectancies for selected risk factors and chronic conditions in Canada. *Journal of Women and Aging* 2002; 14(2). In press.

25 Wigle DT, Mao Y. *Mortality by Income Level in Urban Canada*. Ottawa: Non-Communicable Disease Division, Laboratory Centre for Disease Control, Health Protection Branch, Minister of National Health and Welfare, 1980.

26 Wilkins R. L'inégalité sociale face à la mortalité à Montréal, 1975-1977. *Cahiers québécois de démographie* 1980;9(2):157-84.

27 Guillemette A. L'évolution de la mortalité différentielle selon le statut socio-économique sur l'Île de Montréal, 1961-1976. *Cahiers québécois de démographie* 1983; 12(1): 29-50.

28 Wilkins R, Adams O, Brancker A. Changes in mortality by income in urban Canada from 1971 to 1986. *Health Reports* (Statistics Canada, Catalogue 82-003) 1989; 1(2): 137-74.

29 Choinère R. Les disparités géographiques de la mortalité dans le Montréal métropolitain, 1984-1988 : étude écologique des liens avec les conditions sociales, économiques et culturelles. *Cahiers québécois de démographie* 1991; 20(1): 115-44.

30 Wilkins R, Sherman GJ, Best PAF. Birth outcomes and infant mortality by income in urban Canada, 1986. *Health Reports* (Statistics Canada, Catalogue 82-003) 1991; 3(1): 7-31.

31 Wilkins R. Socio-economic differentials in stroke mortality in Canada: data by neighbourhood income quintile, sex and age group in 1971 and 1986. *Chronic Diseases in Canada* 1994; 15(1): 33-5.

32 Courteau JP, Trempe N. Variations de la mortalité selon le taux de pauvreté en Outaouais urbain et dans l'ensemble du Québec urbain. *Cahiers québécois de démographie* 1996; 25(2): 211-40.

33 Choinière R. *Les inégalités socio-économiques de l'état de santé et de bien-être de la population de Montréal-Centre*. Montréal: Régie régionale de la santé et des services sociaux de Montréal-Centre, Direction de la santé publique, 1997.

34 Lessard R (director). *1998 Annual Report on the Health of the Population. Social Inequalities in Health*. Montréal: Régie régional de la santé et des services sociaux de Montréal-Centre, Direction de la santé publique, 1998.

35 Wilkins R, Houle C, Berthelot JM, Ross N. The changing health status of children in Canada. *Isuma* 2000; 1(2): 58-63.

36 Pappas G, Queen S, Hadden W, Fisher G. The increasing disparity in mortality between socioeconomic groups in the United States, 1960 and 1986. *New England Journal of Medicine* 1993; 329: 103-9.

37 Pearce N, Marshall S, Borman B. Undiminished social class mortality differences in New Zealand men. *New Zealand Medical Journal* 1991; 104(910): 153-6.

38 Dahl E, Kjaersgaard P. Trends in socioeconomic mortality differentials in post-war Norway: evidence and interpretations. *Sociology of Health and Illness* 1993; 15(5): 587-611.

39 Valkonen T. Problems in the measurement and international comparisons of socio-economic differences in mortality. *Social Science and Medicine* 1993; 36(4): 409-18.

40 Regidor E, Gutierrez-Fisac JL, Rodriguez C. Increased socioeconomic differences in mortality in eight Spanish provinces. *Social Science and Medicine* 1995; 41: 801-7.

41 Davey Smith G, Doorling G, Mitchell R, Shaw M. Health inequalities in Britain: Continuing increases up to the end of the 20th century. *Journal of Epidemiology and Community Health* 2002; 56(6): 434-5.

42 Williams DR. Race, socioeconomic status and health. The added effects of racism and discrimination. *Annals of the New York Academy of Science* 1999; 896: 173-88.

43 Martikainen P, Valkonen T. Diminishing educational differences in breast cancer mortality among Finnish women: a register-based 25-year follow-up. *American Journal of Public Health* 2000; 90(2): 277-80.

44 Valkonen T, Martelin T, Rimpela A. *Socio-economic Mortality Differences in Finland 1971-85.* Helsinki: Statistics Finland, 1990.

45 Turrell G, Mathers C. Socioeconomic inequalities in all-cause and specific-cause mortality in Australia: 1985-1987 and 1995-1997. *International Journal of Epidemiology* 2000; 29: 231-9.

46 Valkonen T, Martelin T, Rimpela A, et al. *Socio-economic Mortality Differences in Finland 1981-90.* Helsinki: Statistics Finland, 1993.

47 Bennett S. Socioeconomic inequalities in coronary heart disease and stroke mortality among Australian men, 1979-1993. *International Journal of Epidemiology* 1996; 25(2): 266-75.

48 Wilkins R. *PCCF+ Version 3J User's Guide (Geocodes/PCCF). Automated Geographic Coding Based on the Statistics Canada Postal Code Conversion Files, Including Postal Codes to May 2002* (Catalogue 82F0086-XDB). Ottawa: Health Analysis and Measurement Group, Statistics Canada, 2002 July.

49 Statistics Canada. *Statistics on Low Income 1970* (Catalogue 93-773). Ottawa: Statistics Canada, 1977.

50 Statistics Canada. *Dictionary. Census Canada, 1986* (Catalogue 92-101E). Ottawa: Statistics Canada, 1987.

51 Statistics Canada. *1991 Census Dictionary* (Catalogue 92-301E). Ottawa: Statistics Canada, 1992.

52 Statistics Canada. *1996 Census Dictionary, Final Edition* (Catalogue 92-351-UPE). Ottawa: Statistics Canada, 1999.

53 National Center for Health Statistics. *International Classification of Diseases, Adapted.* 8th rev. Washington, D.C.: US Government Printing Office, 1967.

54 World Health Organization. *International Classification of Diseases, 1975 revision*. Geneva: World Health Organization, 1978.

55 Chiang CL. *The Life Table and Its Applications*. Malabar, Florida: Robert E. Krieger Publishing Company, 1984.

56 Romeder JM, McWhinnie JR. Potential years of life lost between ages 1 and 70: an indicator of premature mortality for health planning. *International Journal of Epidemiology* 1977; 6(2): 143-51.

57 Fleiss JL. *Statistical Methods for Rates and Proportions.* 2nd ed. New York: John Wiley and Sons, 1981.

58 Rothman KJ. *Modern Epidemiology*. Boston: Little, Brown and Company, 1986.

59 Kelsey JL, Whittemore AS, Evans AS, Thompson WD. *Methods in Observational Epidemiology.* 2nd ed. New York: Oxford University Press, 1996.

60 Spiegelman M. *Introduction to Demography*. Revised ed. Cambridge, Massachusetts: Harvard University Press, 1968.

61 Brillinger DR. The natural variability of vital rates and associated statistics. *Biometrics* 1986; 42: 693-734.

62 Carrière KC, Roos L. A method of comparison for standardized rates of low-incidence events. *Medical Care* 1997; 35(1): 57-69.

63 Statistics Canada. *Profile Series: Canada, All Levels of Geography* (CD-ROM) (Catalogue 92F0020XCB). Ottawa: Statistics Canada, 1998.

64 Middelkoop BJC, Struben HWA, Burger I, Vroom-Jongerden JM. Urban cause-specific socioeconomic mortality differences. Which causes of death contribute most? *International Journal of Epidemiology* 2001; 30: 240-7.

65 Alter DA, Naylor CD, Austin P, Tu JV. Effects of socioeconomic status and access to invasive cardiac procedures on mortality after acute myocardial infarction. *New England Journal of Medicine* 1999; 341: 1359-67.

66 Macintyre K, Stewart S, Chalmers J, et al. Relation between socioeconomic deprivation and death from a first myocardial infarction in Scotland: population based analysis. *British Medical Journal* 2001; 322: 1152-3.

67 Pekkanen J, Tuomilehto J, Uutela A, et al. Social class, health behaviour, and mortality among men and women in eastern Finland. *British Medical Journal* 1995; 311: 589-93.

68 Diez Roux AV, Merkin SS, Arnett D, et al. Neighbourhood of residence and incidence of coronary heart disease. *New England Journal of Medicine* 2001; 345(2): 99-106.

69 Rosengren A, Wedel H, Wilhelmsen L. Coronary heart disease and mortality in middle aged men from different occupational classes in Sweden. *British Medical Journal* 1988; 297: 1497-500.

70 Wamala SP, Lynch J, Kaplan G. Women's exposure to early and later life socioeconomic disadvantage and coronary heart disease risk: the Stockholm female coronary risk study. *International Journal of Epidemiology* 2001; 30: 275-84.

71 Jaglal SB, Goel V. Social inequity in risk of coronary artery disease in Ontario. *Canadian Journal of Cardiology* 1994; 10(4): 439-43.

72 Millar WJ, Stephens T. Social status and health risks in Canadian adults: 1985 and 1991. *Health Reports* (Statistics Canada, Catalogue 82-003) 1993; 5(2): 143-56.

73 Pomerleau J, Pederson LL, Ostbye T, et al. Health behaviours and socio-economic status in Ontario, Canada. *European Journal of Epidemiology* 1997; 13(6): 613-22.

74 Che J, Chen J. Food insecurity in Canadian households. *Health Reports* (Statistics Canada, Catalogue 82-003) 2001; 12(4): 11-2.

75 Maxwell CJ, Bancej CM, Snider J, Vik SA. Factors important in promoting cervical cancer screening among Canadian women: findings from the 1996-97 National Population Health Survey (NPHS). *Canadian Journal of Public Health* 2001; 92(2): 127-33.

76 Cnattingius S, Haglund B. Socio-economic factors and feto-infant mortality. *Scandinavian Journal of Social Medicine* 1992; 20(1): 11-3.

77 Johnson KC, Hu J, Mao Y, Canadian Cancer Registries Epidemiology Research Group. Passive and active smoking and breast cancer risk in Canada, 1994-1997. *Cancer Causes and Control* 2000; 11: 211-21.

78 Perron L, Moore L, Bairati I, et al. PSA screening and prostate cancer mortality. *Canadian Medical Association Journal* 2002; 166(5): 600-1.

79 World Health Organization. *Targets for Health for All.* Copenhagen: World Health Organization Regional Office for Europe, 1985.

80 Gorey KM, Holowaty EJ, Fehringer G, et al. An international comparison of cancer survival: Toronto, Ontario, and Detroit, Michigan, metropolitan areas. *American Journal of Public Health* 1997; 87(7): 1156-63.

81 Hein HO, Suadicani P, Gyntelberg F. Lung cancer risk and social class. The Copenhagen male study—17 year follow up. *Danish Medical Bulletin* 1992; 39: 173-6.

82 Hart CL, Hole DJ, Gillis CR, et al. Social class differences in lung cancer mortality: risk factor explanations using two Scottish cohort studies. *International Journal of Epidemiology* 2001; 30: 268-74.

83 Martikainen P, Lahelma E, Ripatti S, et al. Educational differences in lung cancer mortality in male smokers. *International Journal of Epidemiology* 2000; 29: 264-7.

84 Johnson KC, Hu J, Mao Y, Canadian Cancer Registries Epidemiology Research Group. Lifetime residential and workplace exposure to environmental tobacco smoke and lung cancer in never-smoking women, Canada, 1994-97. *International Journal of Cancer* 2001; 93: 902-6.

85 Mao Y, Hu J, Ugnat AM, et al. Socioeconomic status and lung cancer risk in Canada. *International Journal of Epidemiology* 2001; 30(4): 809-17.

86 Hogg RS, Strathdee SA, Craib KJ, O'Shaughnessy MV, Montaner JS, Schechter MT. Lower socioeconomic status and shorter survival following HIV infection. *Lancet* 1994; 344(8930): 1120-4.

87 Schechter MT, Hogg RS, Aylward B, Craib KJ, Le TN, Montaner JS. Higher socioeconomic status is associated with slower progression of HIV infection independent of access to health care. *Journal of Clinical Epidemiology* 1994; 47(1): 59-67.

88 Wilkins K. Tuberculosis, 1994. *Health Reports* (Statistics Canada, Catalogue 82-003) 1996; 8(1): 33-9.

89 Wobeser WL, Yuan L, Naus M, Corey P, Edelson J, Heywood N, et al. Expanding the epidemiologic profile: risk factors for active tuberculosis in people immigrating to Ontario. *Canadian Medical Association Journal* 2000; 163(7): 823-8.

90 Cantwell MF, McKenna MT, McCray E, Onorato IM. Tuberculosis and race/ethnicity in the United States. *American Journal of Repiratory and Critical Care Medicine* 1998; 157: 1016-20.

91 Robbins JM, Vaccarino V, Zhang H, Kasl SV. Socioeconomic status and type 2 diabetes in African American and non-Hispanic white women and men: Evidence from the Third National Health and Nutrition Examination Survey. *American Journal of Public Health* 2001; 91: 76-83.

92 Chen J, Wilkins R, Ng E. Health expectancy by immigrant status, 1986 and 1991. *Health Reports* (Statistics Canada, Catalogue 82-003) 1996; 8(3): 29-37.

93 Nam CB. Another look at mortality cross overs. *Social Biology* 1995; 42(12): 133-42.

94 Myles J, Picot G, Pyper W. *Neighbourhood Inequality in Canadian Cities.* Analytical Studies Branch Research Paper Series No. 160 (Catalogue 11F0019MPE00160). Ottawa: Statistics Canada, 2000.

95 Heisz A. *Low-Income Intensity among Urban and Rural Canadians: 1993 and 1997.* Analytical Studies Branch Research Paper Series No. 161 (Catalogue 11F0019MPE01161). Ottawa: Statistics Canada, 2001.

96 Morissette R, Zhang X, Drolet M. *The Evolution of Wealth Inequality in Canada, 1984-1999.* Analytical Studies Branch Research Paper Series No. 187 (Catalogue 11F0019MPE02187). Ottawa: Statistics Canada, 2002.

97 Wolfson MC, Murphy BB. *New Views on Inequality Trends in Canada and the United States.* Analytical Studies Branch Research Paper Series No. 124 (Catalogue 11F0019MPE98124). Ottawa: Statistics Canada, 1998.

98 Séguin L, Kantiébo M, Xu Q, et al. Standard of living, health and development, Part I—Poverty, health conditions at birth and infant health. In: *Longitudinal Study of Child Development in Québec (ÉLDEC 1998-2002)*. Québec: Institut de la statistique du Québec, 2001; 1(3): 25-60.

99 Paquet G, Girard M, Dubois L. Standard of living, health and development, Part II—Social inequality and child development. In: *Longitudinal Study of Child Development in Québec (ÉLDEC 1998-2002)*. Québec: Institut de la statistique du Québec, 2001; 1(3): 63-87.

100 Marrett L, Chaudhry R, Fair M, et al. *The Study of the Feasibility of Linking Census Occupation Data and the Ontario Cancer Registry and Mortality Data Base. Final Report for the Occupational Diseases Panel.* Toronto: Ontario Cancer Treatment and Research Foundation, 1996.

101 Berthelot JM, Mustard C, Wilkins R, Chonière R. *Cohort Mortality by Socioeconomic Characteristics for a 15% Sample of the 1991 Population of Canada*. Research programme proposal funded by the Canadian Population Health Initiative (CPHI). Ottawa: Health Analysis and Measurement Group, Statistics Canada, 2001.

102 Rogot E, Sorlie PD, Johnson NJ, et al. *A Mortality Study of One Million Persons by Demographic, Social, and Economic Factors: 1979-1981 Follow-up (First Data Book)*. National Institutes of Health Publication No. 88-2896. Washington, D.C.: US Department of Health and Human Services, Public Health Service, 1988.

103 Sorlie PD, Backlund E, Keller JB. U.S. mortality by economic, demographic and social characteristics: the National Longitudinal Mortality Study. *American Journal of Public Health* 1995; 85: 949-56.

104 Elo IR, Preston SH. Educational differentials in mortality: United States, 1979-85. *Social Science and Medicine* 1996; 42(1): 47-57.

105 Fox AJ, Goldblatt PO. *Longitudinal Study. Socio-demographic Mortality Differentials*. Series LS No. 1. London: Her Majesty's Stationery Office, 1982.

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

107 Sacker A, Firth D, Fitzpatrick R, et al. Comparing health inequality in men and women: prospective study of mortality 1986-96. *British Medical Journal* 2000; 320(7245): 1303-7.

108 Desplanques G. *La mortalité des adultes: résultats de 2 études longitudinales (période 1955-1980)*. Paris: Institut National de la Statistique et des Études Économiques, 1984.

109 Leclerc A, Lert F, Goldberg M. Les inégalités sociales devant la mort en Grande-Bretagne et en France. *Social Science and Medicine* 1994; 19(5): 479-87.

110 Faggiano F, Lemma P, Costa G, et al. Cancer mortality by educational level in Italy. *Cancer Causes and Control* 1995; 6(4): 311-20.

111 Merler E, Benvenuti A, Baldi P, et al. [Socioeconomic inequalities in health in the Tuscany Longitudinal Study (SLTO): persistence and changes over time in overall mortality and selected causes (lung cancer, liver cirrhosis, AIDS and overdose.)] *Epidemiologia e Prevenzione (Milano)* 1999; 23(3): 207-14.

112 Borell C, Regidor E, Arias LC, et al. Inequalities in mortality according to educational level in two large southern European cities. *International Journal of Epidemiology* 1999; 28(1): 58-63.

113 Lynge E. Occupational mortality and cancer analysis. *Public Health Reviews* 1990-1991; 18(2): 99-116.

114 Lynge E, Andersen O. Unemployment and cancer in Denmark, 1970-1975 and 1986-1990. *IARC Scientific Publications* 1997; (138): 353-9.

115 Dahl E, Kjaersgaard P. Social mobility and inequality in mortality. An assessment of the health selection hypothesis. *European Journal of Public Health* 1993; 3: 124-32.

116 Vagero D, Norell SE. Mortality and social class in Sweden—exploring a new epidemiological tool. *Scandinavian Journal of Social Medicine* 1989; 17(1): 49-58.

117 Ostberg V, Vagero D. Socio-economic differences in mortality among children. Do they persist into adulthood? *Social Science and Medicine* 1991; 32(4): 403-10.

118 Olausson PO. Mortality among the elderly in Sweden by social class. *Social Science and Medicine* 1991; 32(4): 437-40.

119 Ostberg V. Social class differences in child mortality, Sweden 1981-1986. *Journal of Epidemiology and Community Health* 1992; 46(5): 480-4.

120 Kalediene R, Petrauskiene J. Inequalities in life expectancy in Lithuania by level of education. *Scandinavian Journal of Public Health* 2000; 28(1): 4-9.

121 Eisenbach Z, Manor O, Peritz E, Hite Y. The Israel Longitudinal Mortality Study—differential mortality in Israel 1983-1992: Objectives, materials, methods and preliminary results. *Israel Journal of Medical Sciences* 1997; 33(12): 794-807.

122 Manor O, Eisenbach Z, Peritz E, Friedlander Y. Mortality differentials among Israeli men. *American Journal of Public Health* 1999; 89(12): 1807-13.

123 Manor O, Eisenbach Z, Israeli A, Friedlander Y. Mortality differentials among women: the Israel Longitudinal Mortality Study. *Social Science and Medicine* 2000; 51(8): 1175-88.

124 Blakely T, Woodward A, Salmond C. Anonymous linkage of New Zealand mortality and census data. *Australian and New Zealand Journal of Public Health* 2000; 24(1): 92-5.

125 Jordan-Simpson DA, Fair ME, Poliquin C. Canadian farm operators study: methodology. *Health Reports* (Statistics Canada, Catalogue 82-003) 1990; 2(2): 141-55.

126 Wigle DT, Semenciw RM, Wilkins K, et al. Mortality study of Canadian male farm operators: non-Hodgkin's lymphoma mortality and agricultural practices in Saskatchewan. *Journal of the National Cancer Institute* 1990; 82(7): 575-82.

127 Advisory Committee on Health Statistics. *Recommendations Concerning Collection of Basic Socio-demographic Background Variables for Residents of Institutional Collective Dwellings on the 1996 Census of Canada*. Ottawa: Statistics Canada, 1994 May 6.

128 Wilkins R, Adams O. Health expectancy in Canada, late 1970s: demographic, regional and social dimensions. *American Journal of Public Health* 1983; 73(9): 1073-80.

129 Valkonen T, Sihvonen AP, Lahelma E. Health expectancy by level of education in Finland. *Social Science and Medicine* 1997; 44(6): 801-8.

130 Davis P, Graham P, Pearce N. Health expectancy in New Zealand, 1981-1991: social variations and trends in a period of rapid social and economic change. *Journal of Epidemiology and Community Health* 1999; 53(9): 519-27.

131 Geronimus AT, Bound J, Waidmann TA, et al. Inequality in life expectancy, functional status, and active life expectancy across selected black and white populations in the United States. *Demography* 2001; 38(2): 227-51.

132 Cambois E, Robine JM, Hayward MD. Social inequalities in disability-free life expectancy in the French male population. *Demography* 2001; 38(4): 513-24.

133 Advisory Committee on Population Health. *Intersectoral Action . . . Toward Population Health. Report of the Federal/Provincial/Territorial Advisory Committee on Population Health* (Catalogue H39-507/1999). Ottawa: Health Canada, 1999.

Appendix

Table A
Low-income cut-offs in census metropolitan areas, by economic family size and metropolitan area size, Canada, for income received in 1970, 1985, 1990, and 1995 (in current dollars)

Economic family size (persons)	Metropolitan area size							
	100,000 to 499,999				500,000 and over			
	1970	1985	1990	1995	1970	1985	1990	1995
1	$ 2,515	$ 9,719	$ 12,433	$ 14,473	$ 2,686	$ 10,233	$ 14,155	$ 16,874
2	3,647	12,815	16,854	18,091	3,895	13,501	19,187	21,092
3	4,654	17,115	21,421	22,500	4,970	18,061	24,389	26,232
4	5,534	19,779	24,662	27,253	5,910	20,812	28,081	31,753
5	6,186	22,963	26,946	30,445	6,607	24,252	30,680	35,494
6	6,791	25,026	29,248	33,654	7,253	26,488	33,303	39,236
7+	7,446	27,606	31,460	36,864	7,953	29,155	35,818	42,978

Data sources: *Statistics Canada catalogues.*[49-52]

Table B
International Classification of Diseases (ICD) codes corresponding to each cause of death

Cause of death	Code
All causes	001-999
ICD Chapters	
Infectious and parasitic diseases	001-136 8th; 001-139 9th
Neoplasms	140-239
Endocrine, nutritional and metabolic diseases	240-279
Blood diseases	280-289
Mental disorders	290-315 8th; 290-319 9th
Diseases of the nervous system and sense organs	320-389
Circulatory diseases	390-458 8th; 390-459 9th
Respiratory diseases	460-519
Digestive system diseases	520-577 8th; 520-579 9th
Genitourinary diseases	580-629
Complications of pregnancy	630-678 8th; 630-676 9th
Skin and subcutaneous tissue	680-709
Musculoskeletal diseases	710-738 8th; 710-739 9th
Congenital anomalies	740-759
Perinatal conditions	760-779
Symptoms, signs and ill-defined conditions	780-796 8th; 780-799 9th
External causes (all injuries)	E800-E999
Specific causes	
All cancers	140-209 8th; 140-208 9th
Lung cancer	162-163 8th; 162-163, 164.2-164.3,164.8-164.9, 165 9th
Breast cancer	174 8th, 174-175 9th
Uterine cancer	180-182 8th; 179-182 9th
Prostate cancer	185
Diabetes	250
Ischemic heart disease	410-413 8th; 410-414 9th
Cirrhosis of liver	571
Motor vehicle traffic accidents (MVTA)	E810-E819
Pedestrians in MVTA	E814
Suicide	E950-E959

Note: *For cause of death coding in Canada, the 8th revision of the ICD*[53] *(ICDA-8) was used for 1971, and the 9th revision*[54] *(ICD-9) was used for 1986, 1991 and 1996. Codes shown apply to both 8th and 9th revisions unless otherwise specified.*

Table C

Standard errors of age-standardized mortality rates per 100,000 population, all ages, selected causes of death, by sex and neighbourhood income quintile, urban Canada, 1971 to 1996

	Total	Q1	Q2	Q3	Q4	Q5
All causes						
Both sexes						
1971	2.59	6.43	5.88	5.82	5.55	5.62
1986	1.93	4.78	4.46	4.21	4.16	4.38
1991	1.69	4.18	3.91	3.57	3.62	3.99
1996	1.55	3.58	3.54	3.33	3.31	3.71
Males						
1971	4.57	11.29	10.36	10.31	9.71	9.88
1986	3.47	8.33	7.86	7.55	7.53	7.96
1991	3.02	7.07	6.91	6.39	6.51	7.20
1996	2.73	6.11	6.16	5.91	5.87	6.64
Females						
1971	2.97	7.49	6.78	6.67	6.40	6.36
1986	2.20	5.72	5.24	4.82	4.65	4.80
1991	1.94	5.11	4.61	4.09	4.08	4.40
1996	1.80	4.37	4.23	3.85	3.80	4.16
Ischemic heart disease						
Males						
1971	2.79	7.02	6.37	6.36	5.85	5.89
1986	1.88	4.62	4.41	4.17	4.08	4.08
1991	1.50	3.62	3.57	3.19	3.23	3.42
1996	1.31	2.97	3.01	2.85	2.81	3.06
Females						
1971	1.59	4.11	3.70	3.51	3.40	3.27
1986	1.04	2.83	2.52	2.26	2.15	2.15
1991	0.84	2.31	2.02	1.76	1.75	1.84
1996	0.73	1.80	1.73	1.53	1.51	1.68
Injuries except motor vehicle traffic accidents and suicide						
Both sexes						
1971	0.51	1.05	1.11	1.03	1.10	1.35
1986	0.35	0.79	0.74	0.73	0.77	0.95
1991	0.31	0.71	0.67	0.65	0.66	0.85
1996	0.29	0.63	0.65	0.59	0.63	0.78
Cirrhosis of liver						
Males						
1971	0.59	1.05	1.10	1.28	1.26	1.63
1986	0.45	0.86	0.80	0.99	1.02	1.23
1991	0.39	0.77	0.76	0.75	0.89	1.17
1996	0.34	0.65	0.67	0.71	0.78	1.00
Females						
1971	0.37	0.74	0.78	0.86	0.73	1.00
1986	0.25	0.56	0.55	0.56	0.56	0.63
1991	0.22	0.47	0.51	0.42	0.47	0.63
1996	0.18	0.45	0.41	0.41	0.40	0.41
Uterine cancer						
Females						
1971	0.44	0.89	0.93	1.04	1.01	1.05
1986	0.27	0.61	0.61	0.59	0.56	0.67
1991	0.24	0.57	0.56	0.52	0.50	0.62
1996	0.22	0.48	0.51	0.50	0.46	0.54
Perinatal conditions						
Both sexes						
1971	0.29	0.58	0.60	0.66	0.66	0.74
1986	0.18	0.35	0.35	0.40	0.41	0.46
1991	0.14	0.29	0.28	0.29	0.34	0.36
1996	0.15	0.27	0.34	0.35	0.32	0.36
Pedestrians in motor vehicle traffic accidents						
Both sexes						
1971	0.20	0.35	0.38	0.47	0.46	0.48
1986	0.11	0.23	0.23	0.25	0.25	0.30
1991	0.10	0.18	0.22	0.21	0.23	0.26
1996	0.08	0.17	0.18	0.15	0.20	0.22
Motor vehicle occupants						
Both sexes						
1971	0.37	0.88	0.83	0.86	0.84	0.74
1986	0.24	0.60	0.56	0.53	0.52	0.51
1991	0.21	0.56	0.51	0.46	0.45	0.45
1996	0.18	0.47	0.48	0.39	0.38	0.32

	Total	Q1	Q2	Q3	Q4	Q5
Lung cancer						
Males						
1971	1.20	2.86	2.60	2.68	2.65	2.60
1986	1.07	2.31	2.33	2.36	2.37	2.53
1991	0.96	2.16	2.10	2.02	2.11	2.39
1996	0.87	1.86	1.90	1.87	1.90	2.16
Breast cancer						
Females						
1971	0.72	1.93	1.68	1.62	1.55	1.48
1986	0.61	1.52	1.44	1.34	1.31	1.28
1991	0.55	1.40	1.29	1.17	1.10	1.21
1996	0.50	1.29	1.14	1.10	1.07	1.12
Prostate cancer						
Males						
1971	0.70	1.87	1.82	1.74	1.42	1.27
1986	0.63	1.68	1.63	1.36	1.35	1.24
1991	0.57	1.54	1.42	1.27	1.14	1.16
1996	0.50	1.33	1.22	1.11	1.03	1.00
Suicide						
Males						
1971	0.62	1.28	1.28	1.34	1.38	1.55
1986	0.54	1.13	1.07	1.07	1.24	1.48
1991	0.48	0.99	0.98	1.05	1.08	1.23
1996	0.47	1.02	0.92	1.03	1.03	1.26
Females						
1971	0.40	0.95	0.92	0.85	0.85	0.92
1986	0.29	0.61	0.60	0.53	0.69	0.82
1991	0.25	0.45	0.48	0.55	0.52	0.72
1996	0.25	0.44	0.50	0.48	0.60	0.69
Lung cancer						
Females						
1971	0.40	0.98	0.94	0.78	0.94	0.88
1986	0.53	1.23	1.22	1.13	1.13	1.22
1991	0.54	1.37	1.24	1.16	1.14	1.27
1996	0.54	1.24	1.25	1.19	1.15	1.27
Infectious diseases						
Both sexes						
1971	0.21	0.46	0.38	0.44	0.45	0.56
1986	0.20	0.42	0.37	0.40	0.45	0.56
1991	0.24	0.43	0.45	0.48	0.56	0.77
1996	0.23	0.42	0.46	0.44	0.52	0.73
Ill-defined conditions						
Both sexes						
1971	0.20	0.40	0.43	0.41	0.41	0.51
1986	0.23	0.49	0.43	0.49	0.50	0.65
1991	0.26	0.55	0.52	0.52	0.58	0.72
1996	0.23	0.46	0.46	0.47	0.52	0.67
Mental disorders						
Both sexes						
1971	0.16	0.32	0.31	0.33	0.29	0.50
1986	0.20	0.45	0.44	0.39	0.40	0.54
1991	0.18	0.48	0.42	0.36	0.38	0.48
1996	0.20	0.48	0.45	0.40	0.43	0.48
Diabetes						
Males						
1971	0.61	1.64	1.37	1.39	1.31	1.22
1986	0.46	1.12	1.17	1.00	0.99	1.00
1991	0.44	1.02	0.96	0.89	0.94	1.08
1996	0.44	0.98	0.96	0.93	0.95	1.10
Females						
1971	0.49	1.18	1.02	1.12	1.04	1.11
1986	0.32	0.83	0.78	0.72	0.70	0.69
1991	0.30	0.82	0.69	0.63	0.65	0.68
1996	0.29	0.72	0.62	0.61	0.57	0.75

Data sources: *Canadian Mortality Data Base and supplemental address files; special tabulations of census population data*
Note: *See Appendix Table B for International Classification of Diseases codes corresponding to each cause. See Table 9 for ASMRs. Data for "all causes" include causes not shown.*

Annex

Many analyses presented in this Health Reports Supplement are based on Statistics Canada's Canadian Community Health Survey (CCHS). Data collection for cycle 1.1 of the CCHS began in September 2000 and was conducted over 14 months. The CCHS covers the household population aged 12 or older in all provinces and territories, except persons living on Indian reserves, on Canadian Forces Bases, and in some remote areas.

Cycle 1.1 of CCHS was designed to collect information at the health region level.[1] For administrative purposes, each province is divided into health regions (HR); each territory is designated as a single HR. When cycle 1.1 of the CCHS was designed, there were 139 health regions in Canada. The CCHS combines data collection for the Burntwood and Churchill health regions in Manitoba because of Churchill's small population. There are two remote health regions for which the CCHS does not collect data: the Région du Nunavik and the Région des Terres-Cries-de-la-Baie-James, both in Québec.

The CCHS uses the area frame designed for the Labour Force Survey as its primary sampling frame. A multistage stratified cluster design was used to sample dwellings within the area frame. A list of the dwellings was prepared, and a sample of dwellings was selected from the list. The majority (83%) of the sampled households came from the area frame, and face-to-face interviews were held with respondents randomly selected from households in this frame. In some HRs, a random digit dialling (RDD) and/or list frame of telephone numbers was also used. Respondents in the telephone frames, who accounted for the remaining 17% of the targeted sample, were interviewed by telephone.

In approximately 82% of the households selected from the area frame, one person was randomly selected; two people were randomly chosen in the remaining households. For households selected from the telephone frames, one person was randomly chosen. The response rate was 84.7%. The responding sample size for cycle 1.1 was 131,535. A total of 6.3% of interviews were obtained by proxy.

References

1 Béland Y. Canadian Community Health Survey– Methodological overview. *Health Reports* (Statistics Canada, Catalogue 82-003) 2002; 13(3): 9-14.