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Trends in "Avoidable" Mortality by Neighbourhood Income in Urban Canada from 1971 to 1996

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SIGNATURE

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Trends in "Avoidable" Mortality by Neighbourhood Income in Urban Canada from 1971 to 1996

Paul Damien James

A thesis submitted to the Faculty of Graduate and Postdoctoral Studies
in partial fulfillment of the requirements for the degree of M.Sc. in Epidemiology

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ABSTRACT

Objective To examine changes in neighbourhood income-related differences in 'avoidable', and other cause, mortality in urban Canada from 1971 to 1996.

Data source Canadian Mortality Database and population censuses for 1971, 1986, 1991 and 1996. The deaths were coded to census tract and grouped into neighbourhood income quintiles.

Methods Deaths were classified as amenable to medical or public health interventions according to seven selected classification lists. Age-standardized period expected years of life lost (SEYLL) were calculated. Quintile differentials were determined using rate ratios and rate differences.

Results From 1971 to 1996, the avoidable SEYLL differences between the richest and poorest quintiles diminished 58.5-72.1% for men and 56.4-82.2% for women, depending on the classification list considered. The SEYLL differences relating to other causes increased 8.0% in men and decreased 0.5% in women.

Conclusion Deaths amenable to medical and public health interventions contributed to reducing socioeconomic mortality disparities in urban Canada.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Introduction

Persisting health and mortality inequalities in Canada have led to important debates regarding the access to, and the usage of, the Canadian health care system. However, it has been difficult to determine the contribution of the health care system to health outcome disparities due to the absence of appropriate population health indicators.

In 1976, Rutstein et al. proposed using "unnecessary untimely deaths" from conditions for which effective public health and medical interventions are available as a population-based indicator of the medical care. This avoidable mortality (AM) concept has since been applied in various studies examining differences in mortality between regions and over time. More recently, investigators have studied the relationship between socioeconomic status and AM to evaluate the contribution of health care to mortality inequalities and to identify potential deficiencies in health care that warrant additional study. Temporal trends in socioeconomic differences in AM have not previously been studied in Canada.

Objective of this study

To examine changes in neighbourhood income-related differences in avoidable, and other cause, mortality in urban Canada from 1971 to 1996.

Methods

Deaths registration and populations data for census metropolitan areas (CMAs) were obtained from the Canadian Mortality Database and population censuses for the years 1971, 1986, 1991 and 1996. The death data were previously coded to census tract (CT) and grouped into neighbourhood income quintiles on the basis of the CT percentage of population below Canada's low-income cut-offs.

Deaths were classified as avoidable using seven selected avoidable deaths classification lists from relevant studies. These lists were also combined to create a master list of avoidable deaths, for which deaths were categorized into those (a) amenable to medical interventions, and (b) those amenable to public health interventions. Deaths from ischaemic heart disease (IHD) were categorized separately and deaths not considered avoidable were classified as deaths from other causes.

Age-standardized mortality, potential years of life lost and period expected years of life lost (SEYLL) rates were calculated. The richest quintile (Q1) was compared to both the poorest quintile (Q5) and the total population (QT). Absolute and relative mortality disparities were determined using rate differences (RDs) and rate ratios (RRs). The mortality indicators as well as the QT-Q1 and Q5-Q1 comparison pairs produced similar results. This study also sought to identify the causes of death that contributed the greatest to mortality inequalities in urban Canada in 1996 and, for those causes that contributed noticeably to absolute mortality disparity, this study presents cause-specific trends, by neighbourhood income quintile.

Results

From 1971 to 1996, Q5-Q1 avoidable SEYLL RDs diminished between 58.5 and 72.1% in men and between 56.4 and 82.2% in women, depending on the avoidable deaths classification list considered. Also, combining all of the lists, Q5-Q1 differences in (a) SEYLL rates amenable to medical intervention decreased 61.4% in men and 78.3% in women, (b) SEYLL rates amenable to public health decreased 59.1% in men and 14.4% in women, (c) SEYLL rates from IHD decreased 57.7% in men and 38.1% in women, while (d) SEYLL rates from other causes increased 8.0% in men and decreased 0.5% in women.

In 1996, IHD, lung cancer, perinatal condition and cerebrovascular disease contributed the most to the all cause QT-Q1 SEYLL RD, together contributing 32 and 37% for males and females, respectively. Avoidable mortality inequalities diminished over time for several causes that contributed noticeably to mortality disparity in 1996. However, mortality disparities for some causes (lung cancer and cerebrovascular disease in males and IHD in females) have not shown consistent reductions, while for other causes (perinatal conditions and congenital cardiovascular anomalies in males and lung cancer in females), inequalities have widened.

Conclusions

Deaths amenable to medical care and public health have contributed to reducing socioeconomic mortality differences in urban Canada. However, the unchanging or widening differences over time in avoidable mortality relating to some causes should serve as a warning sign of possible shortcomings in the Canadian health care system that warrant further study.

Chapter 1 Introduction

1.1 Background

Since the British Working Group on Inequalities in Health published the Black Report in 1982, research on the issue of social disparities in health and mortality has increased around the world.[1-4] Numerous studies have observed substantial disparities in all-cause as well as cause-specific mortality.[5-24] Temporal changes in mortality disparities have been shown to vary between countries. While most studies have reported widening mortality disparities,[9,25-28] some have shown declining differences.[15,29-31]

Canada's universal health care system is organized with a view to ensure access to care on the basis of need, rather than income.[32] Following the long-term goal of "Health for All" declared in Alma Ata and endorsed by all member states of the World Health Organization, the reduction of socioeconomic inequities in health has become an a key objective of health policy in Canada.[33] Yet, despite continued gains in average life expectancy in Canada, socioeconomic differences in mortality and health continue to exist.[3,31,34-40] Although individual socioeconomic differences in morbidity and mortality have been extensively studied at the provincial and regional level,[34,38,39,41-59] studies of health disparities at the national level have been less frequent because nationally-based health statistics lack information on relevant variables such as income, education and occupation.[60,61]

In 1980, Wigle and Mao[62] matched deaths to census tracts using the address information of death certificates and ascertained the income status of the census tracts from 1971 census data. This endeavour was updated in 1989 by Wilkins et al.[30] and again in 2002 by Wilkins et al.[31] in order to examine changes in mortality disparity from 1971 to 1996. These studies have demonstrated that differences in life expectancy between residents of the richest and poorest neighbourhoods in Canada have diminished 6.3 to 5.0 years for males and 2.8 to 1.6 years for females over the 25-year period. However, Wilkins et al.[31] also noted that large mortality differentials in life expectancy still exist in Canada and, in the case of certain causes of death, disparities have been increasing.

Persisting health disparities have led to important debates regarding the access to, and usage of, services offered by Canada's universal health care system. Although it has been demonstrated that differences in primary care visits and hospital use can be explained by differences in medical need and demographic characteristics,[39,63-68] investigations conducted in Ontario[55-57,67] and Winnipeg,[39] as well as a national survey,[66] have found that higher socioeconomic status was associated with better access to specialized services. On the other hand, many authors have advocated that a large proportion of health disparities in Canada cannot be addressed by medical care services and that future investments should be directed towards social programs and public health.[34,39,40,58,69]

It has been difficult to determine the contribution of the health care system to health outcome disparities due to the absence of appropriate population health indicators.[70-74] Available medical care outcome performance measures in Canada rely on mortality and hospital administrative databases. Examples of these measures include avoidable hospitalizations, hospital deaths, cause-specific complications, patient length of hospital stay, survival after major incident (e.g. myocardial infarction) or surgery, readmissions and access to technology. [75] Although these outcomes are important for evaluating the quality of medical care services, they provide little insight to the impact of medical care on the population. All-cause mortality (or life-expectancy) and premature mortality (mortality of persons less than a specified age) provide a valuable indication of a populations' health, however they do not indicate the impact of health care. Although cause-specific incidence and/or mortality trends have been used as outcome indicators for particular health services, these trends represent only specific health care services when considered separately.

In 1976, the Working Group on Preventable and Manageable Diseases proposed using "unnecessary untimely deaths" as an indicator of medical care quality.[76] The Working Group presented lists of conditions for which deaths may be 'avoidable' if appropriate medical care is provided in a timely fashion. The avoidable mortality (AM) concept has since been applied in various investigations examining differences in mortality between regions and over time. Temporal trend analyses have demonstrated remarkable declines in AM over the past decades that were much more pronounced when compared to mortality from other causes.[77-81] In the Netherlands, Mackenbach et al.[82] demonstrated that declines in mortality from avoidable causes of death were preceded by the introduction of successful medical interventions for those causes. These observations have been used to argue that improvements in medical care have contributed to mortality declines. Following this reasoning, regional comparisons of AM have been conducted in order to highlight areas with excess mortality and stimulate further inquiry so that appropriate measures can be taken.[72,77,83-90] Although these studies refer to the Working Group's original publications, their causes of death selections and methods of analyses differ substantially.[73] Later works using the AM concept included causes of death amenable to public health as well as medical interventions.[90-94]

More recently, studies have examined the relationship between personal socioeconomic status and AM. The main purpose of these investigations has been to evaluate the contribution of health care to mortality inequalities and signal possible deficiencies that warrant additional study.[9,35,92,95-97] For example, Poikolainen and Eskola[96] demonstrated that the deprived occupation-based social groups in Helsinki, Finland had a greater risk of dying from a medically amenable causes of death during the period 1980-1986 (adjusted relative risk of 8.5, 95%CI 6.9-10.6 for the lowest social class compared to the highest social class). Poikolainen and Eskola suggested that these deprived groups need special help from health care. In Sweden, Westerling et al.[92] found small mortality differences between blue- and white-collar workers from causes amenable to medical care, but significant ($p<0.05$) differences for causes amenable to health policy during the 1986-1990 time period. Furthermore, they demonstrated a greater risk of AM ($p<0.01$) among the non-working population, which Westerling et al. interpreted as a warning sign for the Swedish health care system.

Only a few previous studies have examined changes in socioeconomic AM disparity over time. Mackenbach et al.[9] found that mortality from medically amenable causes declined more in the higher occupational classes than in the lower classes in England and Wales from 1930-1932 to 1982-1983. Mackenbach et al. concluded that medical care contributed to the widening mortality differences between socioeconomic groups. In New Zealand, Marshall et al.[95] showed that although the social class gradient for medically amenable mortality diminished from 34% in

1975-1977 to 28% in 1985-1987, the social class inequalities in the latter period were greater for amenable causes of death compared to non-amenable causes (14.1% in 1985-1987) and that the mortality gradient for some amenable conditions increased. Marshall et al. noted that the widening social class differences in mortality from these causes presented a warning signal to the New Zealand health services.

Although there have been numerous applications of the AM concept in Canada,[35,81,98-101] only one study has examined socioeconomic mortality disparities from avoidable causes. Wood et al.[35] examined rates of mortality among occupation-based social classes and socioeconomic groups of British Columbian males from causes of death amenable to medical intervention. Wood et al. found that, for the time period 1981-1991, men of lower social classes experienced greater mortality amenable to medical intervention compared to men of higher social classes (RR 1.9, 95%CI 1.3-2.6 for the lowest social group compared to the highest social group). Temporal trends in socioeconomic differences in AM have not previously been studied in Canada. This study examines trends in AM by neighbourhood income in urban Canada over a recent 25-year period.

1.2 Objectives of This Study

Primary objective: To examine changes in neighbourhood income-related differences in 'avoidable', and other cause, mortality in urban Canada from 1971 to 1996.

Secondary objectives:

- To determine whether applying different avoidable deaths classification lists from the literature would influence the observed time-trends in income-related avoidable mortality differences.
- To examine changes in income-related differences in mortality amenable to medical and public health intervention as well as mortality from other causes not classified as avoidable.
- To ascertain which avoidable causes of death contributed the most to all cause absolute mortality disparity in urban Canada in 1996.
- To present cause-specific avoidable mortality trends, by neighbourhood income quintile, for those causes that contributed noticeably to all cause mortality disparity in 1996.

Hypotheses:

1. Neighbourhood income-related differences in avoidable mortality diminished in urban Canada from 1971 to 1996.
2. The reduction in neighbourhood income-related mortality differences was more pronounced for avoidable causes of death compared to other causes.

1.3 Literature Review

1.3.1 'Avoidable' Mortality Review

The purpose of this section is to review the development of the AM concept. First, the history of the avoidable deaths concept is summarized. Second, differences in avoidable deaths classification practices are discussed. Third, studies involving the AM concept are reviewed. Finally, the findings of these studies are discussed as well as their implications.

History

In 1976, the Working Group on Preventable and Manageable Diseases, directed by David D. Rutstein, proposed using "unnecessary untimely deaths" as indicators of health care quality.[76] The Working Group presented three lists of conditions for which deaths may be avoidable if appropriate medical care is provided in a timely manner. The first list represented causes of death for which a single case of disease or disability or a single death would justify the question "Why did this happen?" Rutstein et al. argued that a death from the conditions mentioned in this list could be considered 'sentinel health events' and thus could serve as negative indices of the quality of medical care. The second list represented conditions where increases in the rates of incidence, disability, or death could serve as a warning sign that there may be a problem with medical care justifying further investigation. The third list comprised of general categories of diseases for which further investigation was recommended to determine their usefulness as indices of quality of care. In total, 91 conditions were identified for which effective medical interventions and prevention measures were available. In 1980, these lists were updated by this the Working Group based on changes in cause of death coding and medical advances.[102]

Charlton et al.[72] were the first to adopt the AM concept in 1983. There were some notable differences between the Working Group's lists and the causes of death selected by Charlton et al. First, conditions primarily sensitive to preventive efforts were excluded. Second, causes of death for which 200 or fewer deaths occurred in England and Wales during the period 1974-1978 were excluded. And third, age ranges were selected for each cause in order to increase the proportion of deaths studied that were potentially avoidable. Fourteen diseases were selected to study variation in avoidable mortality among area health authorities in England and Wales. Following the work by Charlton et al., other investigators in Europe have applied AM concept to study mortality variation over time and between populations.[77,85,86,103,104]

These developments led to the creation of a European Community Concerted Action Project on Health Services and "Avoidable Deaths" (ECCAP) in the 1980s.[89,105] Initially, 10 member states of the European Community participated, providing mortality data for the years 1974 to 1978 for comparisons. Seventeen causes of death were selected as indicators of primary and secondary interventions, and curative care, using the same principles as the Working Group and Charlton.[84] In 1988, the first European Atlas of "Avoidable Death" was published, followed by other editions that included data from later time periods and time period comparisons.[89,90,94] Following earlier works,[106,107] the European atlases categorized avoidable deaths into indicators of medical care and health policy. The goals of these atlases are to monitor health service performance in a manner that is applicable nationally and internationally, and to relate any variations in mortality to differing health service inputs.[83] These advances gave rise to various projects on AM in many regions, including Sweden,[79] Finland,[78] New Zealand,[95] Japan,[108] Korea,[97] Greenland,[109] the United States,[110] and Canada.[81]

In Canada, there have been several applications of the AM concept. Wigle et al.[98] identified opportunities to prevent premature deaths in Canada by relating avoidable potential years of life lost to common behavioural risk factors. Desmeules and Semenciw[81] examined national temporal trends in mortality from causes amenable to health care from 1959 and 1988. Pampalon[99] investigated regional variations of AM in Quebec. Kjellstrand et al.[100] explored the efficiency of national health care systems by comparing health care expenditures to AM trends in industrialized countries, including Canada. Wood et al.[35] examined mortality from avoidable causes among occupation-based social classes and socioeconomic groups of British Columbia. Recently, Manuel and Mao[101] compared age-standardized mortality from avoidable diseases between the United States and Canada from 1980 to 1996.

Although the majority of AM studies refer to the work done by the Working Group, Charlton et al., and/or Holland and ECCAP, their application of the concept varied. Table 1.1 presents some basic characteristics of the AM investigations whose avoidable deaths classification lists were considered for this study.

Table 1.1: Characteristics of the 'avoidable' mortality investigations whose 'avoidable' deaths classification lists were considered in this study

First Author	Year	Countries; Region	Comparison Populations Definition	Study Period	Number of Causes of Death	Responsible Health Care Sectors	Analytic Methods Presented	Other Variables Studied	Controlled Factors
Charlton[72]	1983	England and Wales	Region	1974-1978	15	Primary Care Hospital	ISMR; Multiple Linear Regression	Regional Social Indicators	Age; Regional Social Indicators
Poikolainen[78]	1986	Finland	Sex	1969 to 1981	21	Primary Care Hospital	CMR; Loglinear regression-based estimation of the effect of health services	Year	None
Mackenbach[82]	1988	The Netherlands	Sex	1950-1968; 1969-1984	35	Primary Care Hospital	Loglinear regression-based estimation of the effect of medical interventions	Time Period	Age
Holland*[89]	1988	European Community	Country; Region	1974-1978	17	Health Policy; Primary Care; Hospital	CMR, ISMR	-	Age
Holland*[94]	1997	European Community	Country; Region	1974-1978; 1980-1984	16	Health Policy; Primary Care; Hospital	CMR, ISMR	Time Period	Age
Humblet[111]	2000	Belgium	Sex	1974-1978; 1980-1984; 1985-1989; 1990-1994	18	Health Policy; Primary Care; Hospital	Standardized Years of Potential Life Lost	Time Period	Age
Nolte[93]	2002	Germany and Poland	Country; Sex	1983-1988; 1992-1997	32	Health Policy; Primary Care; Hospital	ASMR; Life expectancy decomposition-based estimation of the contribution of medical care	Time Period	Age

Abbreviations: CMR= crude mortality rate, ISMR= indirectly standardized mortality rate, ASMR= age-standardized mortality rate (direct method)
* Holland is the editor of the European Community Atlas of "Avoidable Death"

Classifying Deaths as 'Avoidable'

All of the studies reviewed generally selected avoidable causes of death based on the Working Group's lists, generally excluding infrequent causes of death. However, despite the common reference, avoidable deaths classification lists were noticeably dissimilar between investigations. For example, while some studies focused on causes that are amenable to medical interventions (such as appendicitis),[72,82] others included causes that are amenable to public health interventions (such as lung cancer).[79,93] Additionally, some causes of death that were not mentioned in the Working Group's lists (such as cerebrovascular disease) were classified as avoidable in later works.[112]

Many AM studies applied classification lists developed previously. Nolte et al.[93] compared the contribution of medical care to changes in life expectancy in Germany and Poland selecting avoidable causes of death based on the lists proposed by Mackenbach et al.,[82] Holland and ECCAP,[94] and Albert et al.[113] In British Columbia, Wood et al.[35] examined disparities in mortality amenable to medical intervention considering the list of avoidable causes created by Charlton et al.[72]

In addition to examining cause-specific mortality trends, the majority of AM studies grouped avoidable causes together in order to ascertain aggregated AM trends.[78,80,81] Deaths not classified as avoidable were often grouped to determine aggregated 'non-avoidable' mortality trends.[72,82] Further, deaths amenable to health policy were occasionally grouped separately from causes amenable to medical intervention.[93,114] Tobias and Jackson[115] recently expanded on this concept by weighting cause-specific mortality trends by the extent to which deaths could be avoided through primary, secondary and tertiary interventions. For each of the 56 conditions previously considered avoidable in the literature, they partitioned mortality into the proportion of deaths that could have been prevented through lifestyle modification (primary avoidable mortality), early detection and intervention (secondary avoidable mortality), and medical or surgical treatment (tertiary avoidable mortality). For example, appendicitis was considered to be 100% avoidable through tertiary care, while lung cancer was only 5% avoidable through tertiary care and 95% avoidable via primary interventions. Their expansion of the AM concept was done in order to estimate the potential of different components of health care to contribute to future population health gain.[115]

'Avoidable' Mortality Investigations

In general, AM studies have investigated three issues: temporal trends, population comparisons, and the relationship between AM and health care services. Temporal trend analyses were often incorporated into population comparison studies. Some investigations explored all of these issues together.[72,99]

i) Comparing Populations and Temporal Trends

The majority of AM studies have examined regional differences in order to identify regions with excess mortality. The first AM study by Charlton et al.[72] compared mortality rates between area health authorities in England and Wales during 1974-1978. The most recent atlas produced by ECCAP compared AM trends between participating members of the European Community for the periods 1980-1984 and 1985-1989.[83,84] Pampalon[99] studied regional variations in AM in Quebec for the periods 1969-1973 and 1982-1990, and Manuel and Mao[101] compared mortality from avoidable causes between the United States and Canada from 1980-1984 to 1995-1996.

Although regional comparisons of AM have been popular, socioeconomic comparisons have also been conducted.[9,35,72,92,95,99,116,117] For instance, Pampalon[99] examined the association between regional socioeconomic factors and AM levels in Quebec. Ethnic variations in AM have been documented in the United States[116] and Singapore[117]. In British Columbia, Wood et al.[35] compared AM rates between occupation-based social and socioeconomic groups for men aged 15 to 65 years for the period 1981-1991.

Various analytic methods have been used to compare AM between populations. For example, Holland and ECCAP[94] applied indirectly standardized mortality ratios (ISMRs) to adjust for the influence of age structure between populations, whereas work done by Nolte et al.[93] compared directly age-standardized mortality rates, and Poikolainen and Eskola[78] utilized crude mortality rates. Wood et al.[35] compared the mortality experience of the highest and lowest social classes in British Columbia using rate ratios with estimated 95% confidence intervals whereas Westerling et al.[92] tested for significant mortality differences between occupational groups in Sweden using a Chi-square test.

Regression analyses have also been used in AM studies to model mortality trends. For example, Marshall et al.[95] performed weighted regressions of the occupational class mortality rates to estimate the strength of the social class gradients for the periods 1975-1977 and 1985-1987. For some studies, the regression analyses have been applied to adjust for factors, such as disease incidence and severity, which contribute to population mortality differentials but may not be indicative of medical care performance. For example, Poikolainen and Eskola[96] used multiple logistic regression models to adjust for age, sex, and marital status when comparing regional and social class mortality from 'amenable' causes of death in Helsinki, Finland. Adjusting for risk factors has been criticized because it may imply ignoring important aspects of health and health care.[83] For instance, demographic and socioeconomic characteristics have been shown to be associated with health needs. If certain conditions are more prevalent or are more severe in certain populations (e.g. elderly or poor), then health services should adapt to the different needs of those populations. Adjusting for these risk factors suggests that population demographics, disease incidence and social factors do not have to be considered when evaluating the performance of health care.[83]

ii) 'Avoidable' Mortality and Health Services

In attempts to ascertain the relationship between AM levels and health care services, correlation and regressions analyses have been used. For instance, Carr-Hill et al.[118] calculated correlations between mortality from four avoidable causes and regional health care expenditures in England and Wales. Buck and Bull[119] compared the correlations between infant and avoidable death rates with public investment in health facilities, total health expenditures, public health expenditures, and the percentage of medical students passing the United States Foreign Medical Graduate examination.

The regression-based methods used to ascertain the relationship between regional AM levels and health care variables have varied between studies. Poikolainen and Eskola[120] studied the relationship between the logarithm of national mortality rates from (a) amenable, (b) non-amenable, (c) partly amenable and (d) violent causes of death under 65 years of age and the number of doctors, nurses and medical beds in 25 developed countries. Pampalon[99] first performed a Principle Component Analysis to aggregate 10 variables selected to characterize regional health services into 3 components summarizing the health care system in Quebec: resource availability, specialists and other professional activities, and general practitioner services. Second, Pampalon applied stepwise regression, with the ISMR of the three causes of death that presented significant ($p<0.05$) regional mortality variations (tuberculosis, hypertensive and cerebrovascular disease, and perinatal mortality) as the dependent variables and regional levels of (a) the component health care variables, (b) socioeconomic factors, (c) condition incidence or prevalence as the independent variables. Mackenbach et al.[121] applied multiple regression analyses to examine the association between the logarithm of regional ISMRs amenable to medical intervention and regional (a) general practitioner density, (b) hospital bed density, (c) percentage of regional hospital beds in university hospitals, and (d) percentage of beds in small hospitals, controlling for sociodemographic variables. In order to investigate whether the associations between their selected causes and medical care variables were time-dependent, Mackenbach et al. compared the results of their regression analyses over four time periods.

Main Findings

The majority of temporal-trend studies demonstrated remarkable declines in AM over the past decades. For example, in an international study by Charlton and Velez,[77] at least a 50% decline in mortality from avoidable causes was seen during 1950 to 1980 in all six of the countries they observed (United Kingdom, United States, France, Japan, Italy and Sweden). Charlton and Velez argued that the similar trends between these countries, despite their contextual differences, suggest that increased access to health care and improvements in the performance of medical interventions were responsible for the decline. This rapid decline in mortality from avoidable causes was later observed in many other countries such as Finland,[78] the Netherlands,[87] Belgium,[111] New Zealand,[122] Spain,[80] and Canada.[81] In the Netherlands, Mackenbach et al.[82] compared mortality trends between 1950-1968 and 1969-1984. They demonstrated that the introduction of successful cause-specific medical interventions was followed by notable declines in the mortality from related causes. For example, mass influenza vaccinations programs introduced in 1953 were followed by a 24% decline in deaths from infectious diseases per annum during 1950-1968, which is much greater than the 3% annual declines observed during 1969-1984. Additionally, mass cervical cancer screening programs introduced in 1976 led to an increased rate of cervical mortality decline from 1% per year between 1950-1968 to 4% decline per year between 1969-1984. These observations have been used to suggest that the declines in AM were at least partly due the introduction of medical interventions.[82]

Many studies compared the declines in AM with mortality trends from other causes. Despite differences in cause selections and time periods, these studies have all demonstrated that the mortality declines were more pronounced for avoidable causes of death compared to other causes.[72,77,82,112] The authors of these studies suggested that these results support the idea that the declines in mortality reflect improvements in medical care. Poikolainen and Eskola,[78] and later Desmeules and Semenciw,[81] have even attempted to estimate the impact of medical care based on the differences between mortality from avoidable and other causes.

Although all of the regional AM comparison studies have observed geographic variations, analyses relating AM levels to health care variables have yielded weak and inconsistent resutls.[99,120,121] For example, in an international study conducted by Poikolainen and Eskola[120], mortality from avoidable causes was not significantly associated with the supply of medical doctors, nurses and midwives, or hospital beds. Pampalon[99] did not find a significant relationship between the three causes of death that demonstrated the greatest regional mortality variations in Quebec and regional health resources, specialist activities, or general practitioner services. Mackenbach et al.[121] did not find a consistent association between the regional differences in mortality amenable to medical intervention in the Netherlands and the medical care supply variables over the four time periods considered in their study.

On the other hand, a strong negative association between AM and regional socioeconomic conditions has consistently been observed. In the first study by Charlton et al.,[72] mortality from avoidable causes was greater in areas of England and Wales that had poor socioeconomic conditions. Similar findings have also been found in many other areas, including France,[107] Belgium,[106] Finland,[96] the Netherlands,[9] and Quebec.[99] However, these studies were based on ecological analyses of large geographic areas and thus their findings may not hold at the individual- (or small area-) level.[9,92,123]

A relationship between AM and personal socioeconomic status has also been shown in many countries. For instance, Westerling et al.[92] demonstrated an 3.1 to 7.5 times greater risk of dying from avoidable causes of death in non-workers compared to workers in Sweden. Wood et al.[35] showed that men in the lowest social class in British Columbia experienced greater mortality amenable to medical intervention compared to men in the highest social class (RR 1.9, 95%CI 1.3-2.6). However, the level of mortality disparities varied among the avoidable causes considered in these studies. For instance, Wood et al. found significant relative mortality disparities for certain causes of death (such as pneumonia and bronchitis: RR 2.3, 95% CI 1.4-4.0) but not others (such as Hodgkin's disease: RR 0.7, 95%CI 0.2-2.2). Westerling et al.[92] considered deaths amenable to health policy (such as lung cancer and liver cirrhosis) as well as medical intervention and demonstrated that working class mortality disparities from medical care indicators in Sweden were small due to the low number of deaths from these causes. However, AM disparities were significant ($p<0.05$) when considering health policy indicators.

Two previous studies examined temporal trends of AM disparities. Both of these studies focussed on deaths amenable to medical care. Mackenbach et al.[9] utilized their previously developed avoidable deaths classification list[82] to show that the percentage change in mortality amenable to medical intervention was greater among the higher occupational classes of England and Wales from 1930-1932 to 1982-1983. Selecting avoidable deaths using the classification list created by Charlton et al.,[72] Marshall et al.[95] found that the strength of the social class mortality gradient (calculated as the regression-based slope of the social class mortality trend devided by the pooled mortality rate) in New Zealand diminished from 34% in 1975-1977 to 28% in 1985-1987. However, they also demonstrated that the social class mortality inequalities in the latter period were greater for amenable causes of death (28%) than non-amenable causes (14.1%) and that, for certain conditions (such as tuberculosis, appendicitis, and abdominal hernia), the strength of the social gradients increased.

Implications

The differences in avoidable deaths classification lists between studies are noteworthy. This may reflect the context of each study and their data limitations. For example, ECCAP modified their lists of avoidable causes in order to accommodate the data limitations within and between participating countries.[84] There may also be differences in opinion and perspectives regarding the "avoidability" of certain causes of death as well as the role of public health and medical care in preventing deaths. Regardless, the differences in avoidable cause selections are related to the informal nature through which causes of death are chosen. The majority of studies did not justify their selection of avoidable deaths with reviews of available evidence.

However, despite variations in cause selections and analytic methods, all of the temporal trend studies showed remarkable declines in AM. This decline was more pronounced than the decline in mortality from other causes of death, suggesting that the declining mortality can be at least partly attributed to improvements in medical care and health policy.[77,112,121]

Following this reasoning, population comparisons have shown considerable variations in AM within and between countries. Differences in regional mortality levels have been highlighted in order to stimulate inquiry and research at the local levels. More recently, investigations have examined the differences in AM between populations of different socioeconomic status. These studies have consistently observed greater mortality from avoidable causes for populations of lower socioeconomic status.[35]

The studies that have investigated temporal trends of AM disparities have produced conflicting results.[9,95] Mackenbach et al.[9] showed that persons from higher occupation-based classes in England and Wales experienced greater declines in age-standardized mortality amenable to medical care from 1930-1932 to 1982-1983. However, for New Zealand males, Marshall et al. [9] found that the occupation-based social class gradients in age-standardized mortality amenable to medical intervention decreased from 1975-1977 to 1985-1987. However, Marshall et al. also noted that mortality inequalities were greater for amenable causes than non-amenable causes in both periods and that, for some conditions, the social class mortality gradients were increasing. In both studies, the authors suggested that the trends they observed indicated how their health care systems contributed to mortality disparities and highlighted areas that warranted further investigation.

A direct link between regional AM levels and health care services has not been shown. However, this does not prove that mortality from avoidable causes is not a valid indicator of health care performance. There are two reasonable explanations for the weak associations offered in the literature. First, the health care variables used to indicate health services were crude measures of the supply or use of health care services.[73,118] For example, the amount of resources a hospital uses may not indicate the quality of care offered by that hospital. Rather, it may be more important how a hospital uses its resources in order to provide optimal effective care and how accessible the hospital is to the populations. Second, health care resource allocation in many countries is determined, at least somewhat, using regional mortality data as an indicator of need. Therefore, it should not be surprising that a greater proportion of health care resources is in regions where mortality rates are relatively high.[73,118]

Although we are uncertain about the true relationship between health care and deaths from avoidable causes, AM can be considered a useful tool that may provide insights into health care and indicate where further research is warranted.[35,95,99]

1.3.2 Issues Related to Area-Based Measures of Socioeconomic Status

The purpose of this section is to review important issues related to using area-based measures of socioeconomic status. First, the validity of using neighbourhood characteristics as a proxy for individual socioeconomic status will be discussed. Second, the concept of contextual effects will be presented. Finally, advantages of area-based measures of socioeconomic status will be put forward.

Neighbourhood Characteristics as a Proxy for Individual Socioeconomic Status

In the absence of individual-level socioeconomic data, investigators have linked census data to postal codes in order to utilize residential neighbourhood characteristics to proxy individual socioeconomic status (SES).[61,124-126] This approach assumes that the social and economic characteristics of the geographic areas where people live are directly related to their individual socioeconomic status.

In reality, persons with different social and economic conditions live in the same areas. Thus misclassifying individual SES using area-level measures will occur.[127-130] For example, in a study comparing Montreal school children's parents' individual and area-based indices of education and income, Demissie et al.[127] found that the correlation between enumeration area- or census tract-level SES measures and individual-level SES measures were always less than 0.4. Deonandan et al.[128] showed that although individual occupation-based measures of socioeconomic status where highly correlated with one another for a sample of patients undergoing in vitro fertilization treatment in London, Ontario (between 0.6 and 0.9), they were only moderately correlated with enumeration area-level indicators of income and education (between 0.2 and 0.3).

Persons living in rural areas are particularly prone to misclassification using census data linked to postal codes. This is because rural municipalities tend to share a common post office, for which one postal code would be assigned. Therefore multiple socioeconomic groups would be considered similarly using rural postal code-based measures of SES.[60,61] In Alberta, Sin et al.[129] observed that the association between personal and postal code-based poverty assignments was weaker in non-metropolitan areas compared to metropolitan areas (likelihood ratio of using the lowest income quintile to identify persons living in poverty were 2.01 and 1.26 for metropolitan and non-metropolitan dwellers, respectively). For this reason, using neighbourhood of residence as a proxy for individual SES may not be appropriate outside urban metropolitan areas.[60,61]

Although smaller and more homogeneous areas are defined using urban postal code data,[61,125] misclassification of individual SES based on area-level measures will occur because people living in the same urban neighbourhoods may be heterogeneous in terms of social and economic characteristics. Individual SES has been shown to follow geographic residential patterns related to physical and social environments, and thus individual SES homogeneity within urban areas generally increases as the area size decreases.[61,125,131,132] For example, in Alberta, Southern et al.[133] found that about 60% of patients undergoing cardiac catheterization were misclassified using a forward sortation area (FSA)-based system (each FSA has a median of about 20,000 households) compared to the enumeration area-based system (each enumeration area consists of about 300 households). Somewhat greater misclassification can be expected to occur when using census tract-level compared to enumeration-level measures of SES.[60,125,127,132] To improve measurement validity, it has therefore been suggested that studies employ the smallest and most homogeneous census-defined areas possible.[60,124,125,131]

However, the associations between area-level SES measures based on enumeration areas or census tracts have been comparable.[124,126,130,131,134] For example, after geocoding 1985 health plan membership records in Northern California to geographic regions defined by the 1980 United States census, Kreiger[124] found that block-group (analogous to enumeration area) and census tract measures of SES were similarly associated high blood pressure, height, and smoking status. Using data from the United States National Maternal and Infant Health Survey (NMIHS) national representative database linked to 1990 census data, Soobader et al.[130] observed that the use of block group-level measures of SES did not greatly improve the estimation of self-reported health status compared to census tract-level measures.

In order to assess the measurement validity of using area-based measures of SES to measure health inequalities in Manitoba, Mustard et al.[41] compared the associations between household income and average neighbourhood income with 13 measures of health outcomes. They found the associations to be comparable (i.e. the household odds ratio and the ecologic odds ratin were not significantly different at the $p<0.05$ level) for 10 of the 13 health outcomes (including mortality). Using medical records for 14,420 Californian patients, Kreiger[124] found that individual- and census tract-level measures of SES produced analogous associations between SES and high blood pressure, height, and smoking status.

Therefore, it seems that census tract-based measures can serve to estimate individual SES for the purpose of describing trends in mortality by SES. In this instance, the associations between census tract-level socioeconomic measures and mortality would be expected to be similar to, but underestimate, the underlying associations between individual SES and mortality, as misclassification would occur.[41,60,124,125,132,135]

Contextual Effects

Although area-based measures of SES have traditionally been used to proxy individual SES, they have also been shown to characterize aspects of people's living conditions that cannot be captured by individual-based measures. Recent literature has highlighted the importance of places in understanding social inequalities in health.[60,125,136] The effects of group-level exposures on outcomes have been referred to as contextual effects and the study of these effects has been termed contextual analysis.[137] Studies in this field suggest that, while individual-level information can explain a large proportion of health variations, the socioeconomic context in which people live also independently contributes to health.

For example, Haan et al.[138] conducted a longitudinal analysis of the effects of residential deprivation on mortality risk in Alameda County, California. After adjusting for individual low income as well as age, sex, ethnicity, baseline physical health status, unemployment, education, health practices, social isolation, and psychological uncertainty or depression, Haan et al. found that residence in poverty areas was still associated with increased risk of death (adjusted relative risk [aRR] 1.50, 95%CI 1.03-2.19). Yen and Kaplan[139] later found that the risk of death for poor persons in Alameda County increased as the SES of their residential neighbourhoods increased. Waitzman and Smith[140] observed that, after adjusting for the individual and household characteristics of a representative sample of non-institutionalized United States citizens aged 25 to 54 years, poverty-area of residence was associated with an elevated risk of all-cause mortality (aRR 1.78, 95%CI 1.33-2.38) as well as mortality from cardiovascular disease (aRR 1.88, 95%CI 1.23-2.88) and cancers (aRR 1.97, 95%CI 1.29-3.00). Anderson et al.[135] estimated that approximately one quarter to one third of mortality associated with residence in low-income areas in the United States was independent of personal income. Veugeler et al.[59] failed to demonstrate differences between disadvantaged and advantaged Nova Scotian neighbourhoods for mortality adjusted for age, gender, smoking status, body mass index, and diabetes. They suggested that contextual factors might have less of a role in Canada due to public access to health care and education. However, Veugeler et al did find that the importance of individual income and education for mortality was greater within advantaged neighbourhoods compared to disadvantaged neighbourhoods.

Reasons for this phenomenon have been offered in the literature. In referring to earlier work done by the City of Toronto in 1991, Wilkins[60] described the differences between risk factors and risk conditions. While risk factors could be amenable to change by an individual on their own or with the support of specific interventions, risk conditions are largely beyond the capacity of individuals to control in the short term. Wilkins argued that condition factors depended more on public policies regarding issues such as income distribution, education, housing, and the environment. Smith et al.[132] indicated that neighbourhood characteristics such as transport, retail outlets, leisure facilities, pollution, and social organization, access to health care, crime rates, and welfare services are determinants of health and cannot be measured at the individual-level. Diez-Roux[137] suggested that the probability of adopting certain behaviours may be dependent in part on the degree to which these behaviours are adopted in the community. Curtis and Jones[141] suggested that contextual effects may be mediated through physical and biological risk factors, social relations, and landscape identification. They also suggested that contextual effects might operate differently for different indicators of health.

In order to assess the effect of neighbourhood environmental factors on risk of death in Alameda County, California, Yen and Kaplan[139] developed a three-component neighbourhood social environment scale using available data on neighbourhood commercial stores, parks, types of housing, and motor vehicle accidents. They found that lower-quality social environments were associated with an increased risk of death after adjusting for individual income, age, sex, ethnicity, smoking status, body mass index, alcohol assumption, and perceived health status (adjusted odds ratio [aOR] 1.58, 95%CI 1.13-2.24). In the Netherlands, Bosma et al.[142] observed that persons living in a neighbourhood with a high percentage of persons with financial problems had a higher mortality risk compared to those who live in a neighbourhood with a low percentage of these persons, independent of age, sex, baseline health status, individual income (aOR 1.41, 95% CI 1.02-1.93). They also found that poor housing conditions, social disintegration, and unhealthy psychological profiles were higher in neighbourhoods with low SES. Recently in Helsinki, Finland, Martikainen et al.[143] found that the level of social cohesion in a neighbourhood was significantly associated with mortality independently of individual level characteristics such as education, occupation, and living arrangements (aOR 1.20, 95% CI 1.05-1.37).

Given the probability of contextual effects, studies examining the impact of individual SES on health may need to be concerned with "individual fallacy", where individual-level observations are incorrectly used to explain population patterns of an outcome.[125,137] Ignoring the role of neighbourhood context may lead to an incomplete understanding of the determinants of disease in individuals as well as in populations. As Wilkins[60] suggested, individual factors and contextual effects should be seen as related, but independent, phenomena, and acknowledged as such in analyses and interpretation of population data.

Advantages of Area-Based Measures of Socioeconomic Status

There are several advantages to investigating socioeconomic group differences in mortality using area-based methods. Firstly, in the absence of individual data, geocoding vital statistics to census-defined areas provides an inexpensive approach to describing socioeconomic mortality disparities. Neighbourhood-based measures of SES methods have been shown to provide comparable, if conservative, estimates of individual-level socioeconomic differentials in mortality.[60,124,125] Vital statistics databases provide readily available data for temporal trend analyses that can be applied at the federal, provincial, and local levels. These data are high quality and are regularly applied for population comparisons. Furthermore, unlike longitudinal studies, Canadian vital statistics data do not suffer from loss to follow-up as virtually all deaths are registered.[60,125]

Secondly, neighbourhood-based measures of SES permit classification among persons not easily classified by individual-based measures. For example, one liability of occupation-based measures of SES is that they cannot be directly applied to persons outside of the paid workforce. People who may not be classified include the unemployed, homemakers, persons employed informally, children, students, and retired adults.[144] By offering a measure of SES that is applicable to all persons regardless of age, gender, or employment status, the census-based approach reduces response bias that would normally occur using individual-level socioeconomic methods.[124,125]

Thirdly, neighbourhood SES is a more consistent estimate of peoples' relevant economic circumstances than are income and education. Income has many components, including wage earnings, child support, alimony, and pensions. Income has been shown to fluctuate considerably over the course of a year (or years) and household income may not be predictive of purchasing power for individuals living in the household.[125,145] Education is a generally static characteristic throughout adult life and this stability may prevent the capturing of relevant changes in SES in adulthood that could influence health.[125,146]

Fourthly, unlike individual income, which involves the accumulation of resources over a defined period of time, the neighbourhood in which people live can approximate their accumulated assets or investments up to a given point in time (i.e. their wealth).[144] This may apply especially to elderly individuals, who may have little income, but substantial wealth.[144]

Fifthly, as mentioned previously (see *Contextual Effects*), area-based measures of SES characterize aspects of peoples' living conditions that cannot be measured using individual- or household-level measures. When combined with individual- and/or household-level data, area-based measures of SES provide an opportunity for researchers to conduct contextual analyses and thus observe how SES influences mortality and morbidity at multiple levels.[59,125]

Finally, census data provides the potential to measure SES using various income criteria as well as using information on education, occupation, and parental social class.[60,124] Data from other sources, such as local or national health surveys, the Canadian Medical Association's address registry of physicians, taxation records, and provincial medical insurance beneficiary files can be combined with vital statistics to further our understanding of socioeconomic disparities in health.[40,41,60,125,147,148] For example, Veugelers et al.[59] linked data from the 1990 Nova Scotia Nutrition Survey with (a) the 1991 Canada Census enumeration area and (b) the Nova Scotian administrative and vital statistics databases. Linking these databases, they were able to use information on various neighbourhood characteristics (such as household income, dwelling value, proportion of single parents, and unemployment rate) and individual characteristics (for example, age, gender, smoking status, household income, and education) to examine the influence of neighbourhood factors on mortality.

Chapter 2 Methods

Section 2.1 describes the data sources used in this study and how the data was previously coded. Section 2.1 presents the work done by other investigators and not the work conducted for this study. Sections 2.2 and 2.3 explain how this study analyzed the coded data.

2.1 Data Sources and Coding

2.1.1 Canadian Mortality Database

Death registration data for residents of Canadian census metropolitan areas (CMAs) were obtained from the Canadian Mortality Database for the years 1971, 1986, 1991, and 1996. A CMA is an area consisting of one or more adjacent municipalities with a population of at least 100,000.[31] The data focussed on urban neighbourhoods because they are more clearly defined, and residential segregation by income is more pronounced in large cities compared to small towns and rural areas.[61] For 1971, 22 urban areas were defined by Statistics Canada as CMAs. One CMA (Chicoutimi-Jonquière) was excluded because reference information was not available. The analysis for 1971 was therefore based on 21 CMAs and represented 54% of the total Canadian population. For 1986, 1991, and 1996, 25 areas met the CMA definition and all were included in the study, representing 60% of the total Canadian population.

From the Canadian Mortality Database, the variables extracted included age, sex, usual place of residence, and underlying cause of death.

2.1.2 Geographic Coding: Assignment of Census Tracts

Deaths were previously coded to census tract (CT). CTs are small, relatively stable geographic areas that usually have a population from 2,500 to 8,000. They are defined only in CMAs and in census agglomerations with a population of 50,000 or more.[31]

Street address data from death registrations were used to establish the CT of usual residence for each deceased person. In 1971, CT was determined manually based on street indexes and maps.[62] For 1986, 1991 and 1996, postal codes were generated from the addresses, validated, and then assigned to CT using automatic geographic coding based on the Statistics Canada Postal Code Conversion File (PCCF+).[a][31] For 1986, addresses for which no postal code could be derived or addresses that referenced a post office location were manually assigned to CT using street indexes, maps, and other reference documents. For 1991 and 1996, these addresses were assigned to CT using the probability distributions of census populations by postal code and CT.

2.1.3 Censuses of Population

Census tract population and income data were obtained from the Canadian population censuses for the years 1971, 1986, 1991 and 1996. Persons were classified as having low income if their total economic family income or unattached individual income in the year preceeding each census was below that year's Statistics Canada low-income cut-offs (LICOs). Statistics Canada defines the economic family as all occupants of a dwelling unit

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[a] PCCF+ combines Statistics Analysis Software (SAS) residential coding programs and a series of reference files derived from Statistics Canada to link Canadian 6-digit alphanumeric postal codes to corresponding geographic coordinates and census geography.[9,30,95,97,149]

who are related by blood, marriage, adoption or common-law relationship. An unattached individual is a person who either lives alone or shares a dwelling unit, but is unrelated to the other occupants by blood, marriage, adoption or common-law relationship.

LICOs varied according to family size and CMA. Table 2.1 presents the low-income cut-offs by economic family size and by metropolitan area size from 1971 to 1996.

Table 2.1: Low-income cut-offs in census metropolitan areas, by economic family size, Canada, for income received in 1970, 1985, 1990, and 1995 (in current dollars)

	Metropolitan area size							
Economic family size	100,000 to 499,999				500,000 and over			
(persons)	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	4,910	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

Source: Wilkins et al.[31]

2.1.4 Construction of Quintiles

Within regional CMAs, each CT was ranked according to the percentage of population below the low-income cut-off. CTs were devided into five groups from lowest to highest percentage of low-income residents, such that each quintile comprised approximately one-fifth of the total non-institutional population of the CMA. The quintile data were then pooled across CMAs. By constructing quintiles within CMAs before aggregating data across CMAs, the influence of inter-metropolitan differences in incomes and living costs was minimized.

For the comparison of quintiles, quintile 5 (Q5) refers to areas where the usual residence CT was the poorest (i.e. had the highest percentage of population below the low-income cut-off), and quintile 1 (Q1) refers to areas where the usual residence CT was the richest (i.e. had the lowest percentage of populations below the low-income cut-off). 'QT' refers to the total population (all quintiles combined).

2.2 'Avoidable' Deaths Classification

2.2.1 'Avoidable' Deaths by Classification List

Death records in the Canadian Mortality Database are classified according to the World Health Organization (WHO) Manual of International Statistical Classification of Diseases, Injuries, and Causes of Death, Eighth revision (ICD8) from 1968 to 1978 and the Ninth revision (ICD9) from 1979 to 1999. WHO defines the underlying cause of death as (a) the disease or injury that initiated the sequence of events leading directly to the death, or (b) the circumstance of the accident or violence that caused the injury.[150] When more than one cause of death is listed on the death registration, the underlying cause of death is determined by algorithms that consider the sequence of conditions on the certificate.

For this study, in order to examine the influence of the diverse avoidable deaths classification practices, deaths were classified as avoidable according to 7 avoidable deaths classification lists selected from relevant studies. Tables A.1 to A.7 in Appendix A present the classification lists considered for this study. These lists include the first widely accepted list developed by Charlton et al.,[72] and the list currently being applied by the European Community.[94] The classification lists vary mainly in the causes and age ranges for which deaths were considered avoidable. However, for some causes of death, the ICD8 and/or ICD9 codes also vary between lists. The classification lists are presented with reference to the first author and publication year of the study from which the list is referenced. For example, the list from the study by Poikolainen and Eskola[104] is referred to as "Poikolainen 1986".

2.2.2 Master List of Avoidable Deaths: Deaths Amenbable to Medical Intervention, Deaths Amenable to Public Health, Deaths from Ischaemic Heart Disease and Deaths from Other Causes

The classification lists were then combined to create a "master list" of avoidable deaths (Table A.8 in Appendix A). The causes of death were categorized into causes amenable to medical intervention and causes amenable to public health, following previous studies.[93,111] Deaths amenable to medical intervention are those for which it is reasonable to expect a death to be averted after the condition has developed. This list includes causes such as appendicitis and asthma, where the medical nature of the intervention is apparent. This list also includes causes such as cervical cancer, where deaths are preventable through early detection and effective treatment. Deaths amenable to public health are those for which medical interventions may be less effective for treating the condition, but where there are interventions that are known to prevent the condition from occurring. This group includes lung cancer and liver cirrhosis, which are mainly amenable to lifestyle changes (such as tobacco and alcohol use) and motor vehicle accidents, which are amenable to legislative measures (such as laws regarding speed limits, seatbelts, and helmets).[93] Ischaemic heart disease (IHD) was categorized separately because (a) both medical interventions and public health can contribute to reducing deaths from IHD and (b) the large number of deaths from IHD would conceal the impact of medical care and public health on the other causes of death.[93] The deaths that were not classified as avoidable according to any of the classification lists were classified as deaths from other causes.

According to the "sentinel health events" concept proposed by Rutstein et al.,[76,102] a single death related to certain conditions of death warrants the question "Why did this happen?" These causes are marked with asterisks in the master list (Table A.8 in Appendix A). Quintile death counts for these causes are presented.

2.3 Analysis

2.3.1 Exclusions

i) Institutional Residents

Deaths of residents of long-term care facilities were excluded because the income level of the CT in which an institution was located may be unrelated to the income of its residents. Table 2.2 describes the proportion of all deaths for which the decedent's usual place of residence was an institution, by neighbourhood income quintile. As a proportion of the total population (all quintiles), institutional deaths increased from 1971 to 1996 (from 1.85 to 3.79% for males and from 3.11 to 4.74% for females). In 1971, the richest quintile had the highest percent of institutional deaths. From 1986 to 1996, the richest quintile had the lowest percent of institutional deaths. The trend for institutional deaths between the other quintiles is not clear.

Table 2.2: Total and institutional deaths by neighbourhood income quintile, by sex, urban Canada, 1971 to 1996

		1971			1986			1991			1996		
SEX	QUINTILE	Total	Inst	%*	Total	Inst	%	Total	Inst	%	Total	Inst	%
Males													
	QT (all quintiles)	29,998	564	1.85	32,812	1,159	3.41	32,374	1,149	3.43	32,938	1,297	3.79
	Q1 (richest)	3,824	101	2.57	4,407	119	2.63	4,379	122	2.71	4,881	136	2.71
	Q2	4,624	72	1.53	5,254	143	2.65	5,224	153	2.85	5,504	204	3.57
	Q3	5,540	70	1.25	6,196	183	2.87	6,331	260	3.95	6,172	297	4.59
	Q4	6,089	77	1.25	7,005	268	3.69	7,266	253	3.37	7,142	278	3.75
	Q5 (poorest)	9,388	137	1.44	9,539	385	3.88	9,143	352	3.71	8,886	363	3.93
Femlaes													
	QT (all quintiles)	17,373	558	3.11	19,776	948	4.57	19,666	950	4.61	20,680	1,028	4.74
	Q1 (richest)	2,303	81	3.40	2,753	108	3.78	2,715	93	3.31	3,139	95	2.94
	Q2	2,726	88	3.13	3,177	130	3.93	3,317	144	4.16	3,551	156	4.21
	Q3	3,396	67	1.94	3,852	171	4.25	3,925	228	5.49	3,973	250	5.92
	Q4	3,788	96	2.47	4,358	206	4.51	4,524	233	4.90	4,615	254	5.22
	Q5 (poorest)	4,870	138	2.76	5,442	300	5.23	5,172	243	4.49	5,215	257	4.70

Abbreviation: Inst: institutional
*Percent of the total deaths that were institutional

ii) Census Tracts Not Coded or Excluded

CTs with a non-First Nation reserve household population of less than 250 did not have data on income available and thus could not be incorporated into the analysis. This included institutional CTs with few or no private households, industrial CTs with little or no populations, and most Indian reserves. In 1986, 1991 and 1996, three additional CTs were excluded because they contained large incompletely enumerated Indian reserves.

iii) Age or sex unknown

For 1971, there were 56 decedents whose sex was not recorded. For these, sex was assigned to each death whose cause of death was sex specific (for example, cervical cancer for females). This had a limited effect on sex classification (12 additional deaths were classified this way). Sex was randomly assigned to the remaining deaths, ensuring that 60% of these deaths were classified as male and 40% female. There were 5 decedents in 1971 whose ages were unknown. For 1986, 1991 and 1996, there were fewer than 10 decedents whose age or sex were unknown. These deaths were excluded from the analyses.

iv) Deaths Over 74 Years of Age

Deaths of persons over 74 years of age were excluded because the "avoidability" of deaths above this age is more questionable.[9,151,152] In addition, cause of death certification may be less accurate for deaths at older ages.[153] This cut-off age is consistent with recent literature using the 'avoidable' mortality concept.[86,93,115] It is important to note that by excluding deaths over 74 years of age, most institutional deaths were excluded as well.

2.3.2 Calculations

Avoidable mortality trends were carried out using age-standardized mortality rates, years of life lost rates and age-standardized years of life lost rates. All mortality indicators were expressed as rates per 100,000 population. The denominators for the age-specific rates were year-, quintile-, and sex-specific populations. In adjusting the death rates, 16 age groups (<1, 2-4, 5-9, 10-14, 15-19... 70-74) were used to compute age-specific death rates.

Years of Life Lost

Years of life lost is an indicator of premature mortality that takes into account the age at death. Years of life lost is defined as the number of years persons would have lived had had they experienced normal life expectations.[154] The choice of upper age limit for calculating age-specific remaining years of life varies between studies.[155] For this study, years of life lost were calculated using two methods:

1) Potential years of life lost (PYLL) rates were calculated as described by Romeder and McWhinnie,[155] except that infant deaths were included and age 75 was the upper age limit. The formula applied to calculate the rate of PYLL is presented below:

$$\textbf{PYLL rate} = [\sum_{i=<1}^{70\text{-}74} (L - a_i) \times (d_i)] / N$$

where the sum is over age groups from 0 to 74 years; and L is the arbitrary upper age limit to life (75 years); a_i is the mid-age of age group i; d_i is the number of deaths in the age group i; and N is the number of people in the actual population under 75 years of age.

2) Period expected years of life lost (EYLL) rates were computed as explained by the Global Burden of Disease Project,[156] where the age-specific years of life lost is determined from period life expectancy tables. Wilkins et al.[31] previously developed period life expectancy tables for 1996 according to the method of Chiang.[157] The male and female period life expectancies of the richest quintile (Q1) for 1996 were used. The rate of EYLL was calculated as shown below:

$$\textbf{EYLL rate} = [\sum_{i=<1}^{70\text{-}74} E_i \times (d_i)] / N$$

where the sum is over age groups from 0 to 74 years; E_i is the 1996 period life expectancy for the mid-age of age group i of Q1; d_i is the number of deaths in the age group i; and N is the number of people in the actual population under 75 years of age.

Age-Standardization

To eliminate the effects of different age structures among the populations, mortality rates were age-standardized by the direct method, using the 1991 population of Canada (males and females combined) as the reference population. The formulae for standardizing the death, EYLL and PYLL rates are shown below:

$$\mathbf{ASMR} = \sum_{i=<1}^{70\text{-}74} (\mathbf{d_i} / \mathbf{p_i}) \times (\mathbf{p_{Ri}} / \mathbf{N_R})$$

$$\mathbf{SPYLL\ rate} = \sum_{i=<1}^{70\text{-}74} (\mathbf{L{-}a_i}) \times (\mathbf{d_i} / \mathbf{p_i}) \times (\mathbf{p_{Ri}} / \mathbf{N_R})$$

$$\mathbf{SEYLL\ rate} = \sum_{i=<1}^{70\text{-}74} \mathbf{E_i} \times (\mathbf{d_i} / \mathbf{p_i}) \times (\mathbf{p_{Ri}} / \mathbf{N_R})$$

where ASMR is the age-standardized mortality rate; SPYLL is the age-standardized potential years of life lost; SEYLL is the age-standardized period expected years of life lost; the sum is over age groups from 0 to 74 years; d_i is the number of deaths in the age group i; p_i is the number of people in the actual population age group i; p_{Ri} is the number of people in the reference population age group i; and N_R is the number of people in the reference population under 75 years of age.

Estimating years of life lost using SEYLL or SPYLL did not change the results remarkably (these mortality indicators are compared in Appendix B). Therefore, to simplify the presentation, the results are presented in terms of SEYLL.

Quintile Mortality Comparisons

Mortality trends between Q5 and Q1 (Q5-Q1) were compared to examine the trends in mortality disparity between the poorest and richest quintiles. Mortality trends between QT and Q1 (QT-Q1) rates were compared to investigate the total disparity among the entire population (i.e. Q5, Q4, Q3, Q2 and Q1). The QT-Q1 comparison is known as the income-related population-attributable risk or "excess mortality". The QT-Q1 comparison can be interpreted as the reduction in mortality that would occur if the entire population experienced the mortality level of the richest quintile.[31,158]

The results when comparing QT-Q1 and Q5-Q1 were similar (QT-Q1 and Q5-Q1 comparisons are reviewed in Appendix B). Therefore, to simplify the presentation, only Q5-Q1 avoidable SEYLL rate difference trends are presented. When describing cause-specific mortality disparity trends, the QT-Q1 and Q5-Q1 comparisons will be presented.

Mortality Disparity Measures

Absolute mortality disparity trends were calculated using rate differences (RDs). Relative disparity trends were determined by computing quintile rate ratios (RRs).

RD and RR trends tend to yield patterns that contradict each other. RRs are a function of the changes in the RD as well as changes in the incidence rate of the reference population (a comparison of RRs and RDs is presented in Appendix B).[60,159] For most of the avoidable causes of death considered, mortality has decreased considerably from 1971 to 1996.[31] Therefore, in order to focus on how the quintile differences in avoidable mortality have changed from 1971 to 1996, only the quintile mortality RDs are shown. However, when looking at avoidable mortality by cause of death, the RD and RR trends are presented.

Contribution of 'Avoidable' Causes to All Cause Mortality Disparity

In order to examine the contribution of cause-specific avoidable deaths to all cause mortality disparity, the proportion of all cause QT-Q1 and Q5-Q1 SEYLL RD attributed to each avoidable cause (as defined using the master list) was determined for males and females. Because QT-Q1 and Q5-Q1 comparisons produced similar results, only the QT-Q1 comparison results are presented. Causes of death were ranked according to their contribution to absolute mortality disparity in 1996. To simply the presentation, only those causes that contributed at least 1% in any of the years are shown. Those conditions that did not contribute at least 1% are presented together as "Other avoidable causes".

Sensitivity Analysis

The ranking of avoidable causes (as defined using the master list) according to their contribution to absolute QT-Q1 SEYLL, EYLL, SPYLL, PYLL and ASMR disparity are compared to examine the sensitivity of the results to using different mortality indicators. In addition, the ranking of avoidable causes according to their contribution to absolute Q5-Q1 and QT-Q1 SEYLL disparity are compared to ascertain the sensitivity of the results to comparing the poorest quintile to the richest quintile or the total population to the richest quintile.

Standard Error Estimations

Confidence intervals are presented to describe the precision of the estimates and to determine statistical significance. Table 2.3 presents the formulae used for calculating variances and standard errors for the confidence intervals.

Crude and age-standardized rate variances were calculated assuming that deaths followed a Poisson distribution in each stratum. The formulae used to derive the variance of the rates are described by Spiegleman.[160] The standard errors were derived by taking the square root of the variance. When estimating the confidence intervals for the rates, it was assumed that the rates followed a normal distribution.

The variance for the Q5-Q1 standardized rate difference and rate ratio were calculated as explained by Rothman and Greenland.[123] Both of these variance formulae assume that the rates being compared vary independently. The standard errors were calculated by taking the square root of the variance. For the rate differences, the confidence intervals were assumed to follow a normal distribution. Since the standardized rate ratios follow asymmetric distributions, confidence limits that were symmetric about the natural logarithm of the rate ratios were calculated. The antilogarithm of theses confidence intervals yielded the confidence intervals for the rate ratios.

Georgia Roberts (Statistics Canada, personal communication) derived the variance formula for the QT-Q1 standardized rate difference. This formula takes into account the covariance when comparing the whole population to the richest quintile quintiles. The standard errors were derived by taking the square root of the variance and the confidence intervals were assumed to follow a normal distribution.

A satisfactory method of calculating the QT-Q1 RR accounting for covariance was not derived, and no sources were found in the literature.

Table 2.3: Variance formulae

Calculation	ASMR	YLL	SYLL
Rate	$\Sigma\,(p_{Ri} / N_R)^2 \times [d_i / (p_i)^2]$	$\Sigma\,(YLL_i)^2 \times [d_i / (p_i)^2]$	$\Sigma\ [YLL_i \times (p_{Ri} / N_R)]^2 \times [d_i / (p_i)^2]$
Rate Difference			
Q5-Q1	Variance ($ASMR_{Q5}$) + Variance ($ASMR_{Q1}$)	Variance (YLL_{Q5}) + Variance (YLL_{Q1})	Variance ($SYLL_{Q5}$) + Variance ($SYLL_{Q1}$)
QT-Q1	$\Sigma\,[(p_{Ri} / N_R) / (N_{QTi} \times N_i)\,] \times [N_{QTi}^2 \times (d_{QTi} - d_{Q1i}) + (N_{QT} - N_{Q1i})^2 \times d_{QTi}]$	$\Sigma\,[YLL_i \times (p_{QTi} / N_{QT}) / (N_{QTi} \times N_i)\,] \times [N_{QTi}^2 \times (d_{QTi} - d_{Q1i}) + (N_{QT} - N_{Q1i})^2 \times d_{QTi}]$	$\Sigma\,[YLL_i \times (p_{Ri} / N_R) / (N_{QTi} \times N_i\,)] \times [N_{QTi}^2 \times (d_{QTi} - d_{Q1i}) + (N_{QT} - N_{Q1i})^2 \times d_{QTi}]$
Ln Rate Ratio			
Q5 / Q1	(Variance ($ASMR_{Q5}$)/ $ASMR_{Q5}^2$) + (Variance ($ASMR_{Q1}$)/ $ASMR_{Q1}^2$)	$(N_{Q5}^2 / N_{Q1}^2)^2 \times$ ([Variance (YLL_{Q5})] + $(YLL_{Q5} / YLL_{Q1})^2 \times$ [Variance (YLL_{Q5})]) / YLL_{Q1}	(Variance ($SYLL_{Q5}$)/ $SYLL_{Q5}^2$) + (Variance ($SYLL_{Q1}$)/ $SYLL_{Q1}^2$)

Abbreviations: ASMR: age-standardized mortality rate, YLL: years of life lost rate, SYLL: age-standardized years of life lost rate

Symbols:

Σ: sum over age groups from 0 to 74 years
i: age group
d_i : number of deaths in age group i
p_i : number of persons in the actual population age group i
p_{Ri} : number of persons in the reference population age group i
N: number of persons in the actual population under 75 years of age
N_R: number of persons in the reference population under 75 years of age

YLL_i: years of life lost (calculated using PYLL or EYLL) for the age group I
Q5: poorest quintile
Q1: richest quintile
QT: total population (all quintiles)

Chapter 3 Results

The purpose of this section is to highlight the findings of this study. First, the included populations are described. Second, changes in the poorest quintile-richest quintile (Q5-Q1) 'avoidable' age-standardized period expected years of life lost (SEYLL) rate differences (RDs) from 1971 to 1996 are presented. Third, avoidable causes of death (as defined by the master list) are ranked according to their contribution to the total population-richest quintile (QT-Q1) absolute mortality disparity in urban Canada in 1996. Fourth, mortality time-trends are displayed, by neighbourhood income quintile, for those causes that contributed 1% or more to absolute mortality disparity in urban Canada in 1996. Fifth, sensitivity analyses are shown for the (a) QT-Q1 mortality RD in 1996, applying different mortality indicators, and (b) SEYLL RD in 1996, considering the QT-Q1 and poorest quintile-richest quintile (Q5-Q1) comparisons. Finally, "unnecessary untimely deaths" are presented, by neighbourhood income quintile, for those causes of death that did not contribute greater than 1% to QT-Q1 SEYLL RD in 1996.

3.1 Description of Included Populations

3.1.1 Deaths and Populations

Table 3.1 presents the number of deaths excluded by reason for the exclusion, and Table 3.2 presents the included deaths and populations by neighbourhood income quintile and by sex.

Table 3.1: Total deaths, deaths excluded (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
Reason for exclusion:				
Death registrations not retreived	18	0	0	0
Institutional residents	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	5	4	8	1
Total Deaths remaining for analysis	73,990	88,129	93,328	101,786
Exclude other deaths over 74 years of age	27,442	36,146	41,332	48,708
Non-institutional deaths under 75 years of age	46,548	51,983	51,996	53,078
Non-insitutional population under 75 years of age	11,261,655	14,445,560	15,878,835	16,953,385

Table 3.2: Non-institutional deaths and population under 75 years of age, by neighbourhood income quintile, by sex, urban Canada, 1971 to 1996

	1971			1986			1991			1996		
	Total	Males	Females	Total	Males	Females	Total	Males	Females	Total	Males	Females
Deaths												
QT (all quintiles)	46,548	29,465	17,083	51,983	32,401	19,582	51,996	32,343	19,653	53,078	32,585	20,493
Q1 (richest)	6,127	3,824	2,303	7,160	4,407	2,753	7,094	4,379	2,715	8,020	4,881	3,139
Q2	7,350	4,624	2,726	8,431	5,254	3,177	8,541	5,224	3,317	9,055	5,504	3,551
Q3	8,936	5,540	3,396	10,048	6,196	3,852	10,256	6,331	3,925	10,145	6,172	3,973
Q4	9,877	6,089	3,788	11,363	7,005	4,358	11,790	7,266	4,524	11,757	7,142	4,615
Q5 (poorest)	14,258	9,388	4,870	14,981	9,539	5,442	14,315	9,143	5,172	14,101	8,886	5,215
Population ('000)												
QT (all quintiles)	11,262	5,596	5,665	14,446	7,129	7,316	15,879	7,857	8,022	16,953	8,373	8,581
Q1 (richest)	2,187	1,094	1,092	2,846	1,425	1,422	3,233	1,624	1,610	3,528	1,764	1,764
Q2	2,249	1,117	1,133	2,900	1,445	1,455	3,177	1,577	1,599	3,389	1,678	1,711
Q3	2,258	1,118	1,139	2,896	1,421	1,475	3,198	1,569	1,629	3,371	1,651	1,719
Q4	2,246	1,108	1,138	2,866	1,392	1,475	3,180	1,551	1,628	3,339	1,629	1,710
Q5 (poorest)	2,322	1,160	1,163	2,937	1,447	1,490	3,087	1,533	1,554	3,321	1,647	1,674

3.1.2 Demographic and Socioeconomic Characteristics

Figure 3.1 displays the proportion of populations below the low-income cut-offs (LICOs) by neighbourhood income quintile from 1971 to 1996. From 1971 to 1991, the proportion of persons below the LICOs in each quintile was similar. The gradient between quintile gradient was notably steeper in 1996.

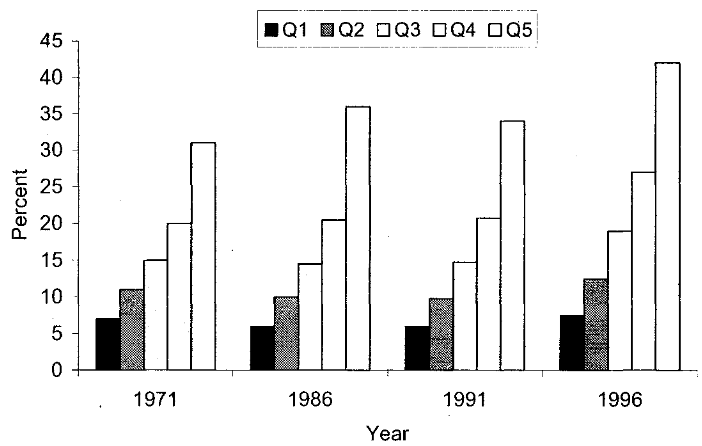

Figure 3.1: Percent of the urban Canadian population below the Statistics Canada low-income cut-offs by neighbourhood income quintile, 1971 to 1996
Source: Wilkins et al.[31]

Table 3.3 presents the socioeconomic characteristics of each neighbourhood income quintile in urban Canada in 1996. Poorer quintiles had greater proportion of people who were unemployed, were not in managerial occupations, had lower education, and did not own their home (i.e. were renters).

Table 3.3: Socioeconomic characteristics of each neighbourhood income quintile, urban Canada, 1996

Income Quintile	Low Income	Average Household Income	IPPE*	Income from Government Transfers	Housing Owned	Foreign Born	Recent Immigrants†	Unemployed§	Managerial Professional Occupations‡	Low Education (<9 years)††
	%	$	$	%	%	%	%	%	%	%
QT (all quintiles)	21.5	51,718	34,901	21.1	58.6	25.1	5.6	9.3	9.8	10.4
Q1 (richest)	7.6	72,944	45,592	7.3	84.7	16.2	2.7	6.1	13.2	5.7
Q2	12.8	61,780	39,636	9.6	75.7	20.4	4.1	7.3	11.0	8.1
Q3	19.2	52,880	35,393	12.0	62.2	25.5	5.6	8.7	9.5	9.8
Q4	27.1	43,921	30,616	15.0	49.4	29.7	6.9	10.6	8.1	13.0
Q5 (poorest)	41.7	33,421	24,531	20.3	30.2	34.0	8.6	14.5	6.7	15.2

Source: Wilkins et al.[31]
*IPPE: 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 years or older.
§As percentage of labour force aged 15 years 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 years and over.

3.2 Q5-Q1 'Avoidable' SEYLL Rate Difference Trends from 1971 to 1996

3.2.1 'Avoidable' Deaths by Classification List

Proportion of All Deaths Under 75 years of age Classified as 'Avoidable'

The avoidable deaths classification lists studied vary in the conditions and age groups for which deaths were considered avoidable. Figure 3.2 displays the proportion of all cause deaths under 75 years classified as 'avoidable' for 5 of the classification lists considered. The lists developed more recently classified a greater proportion of male and female deaths as avoidable. For each classification list, the proportion deaths considered avoidable decreased from 1971 to 1996.

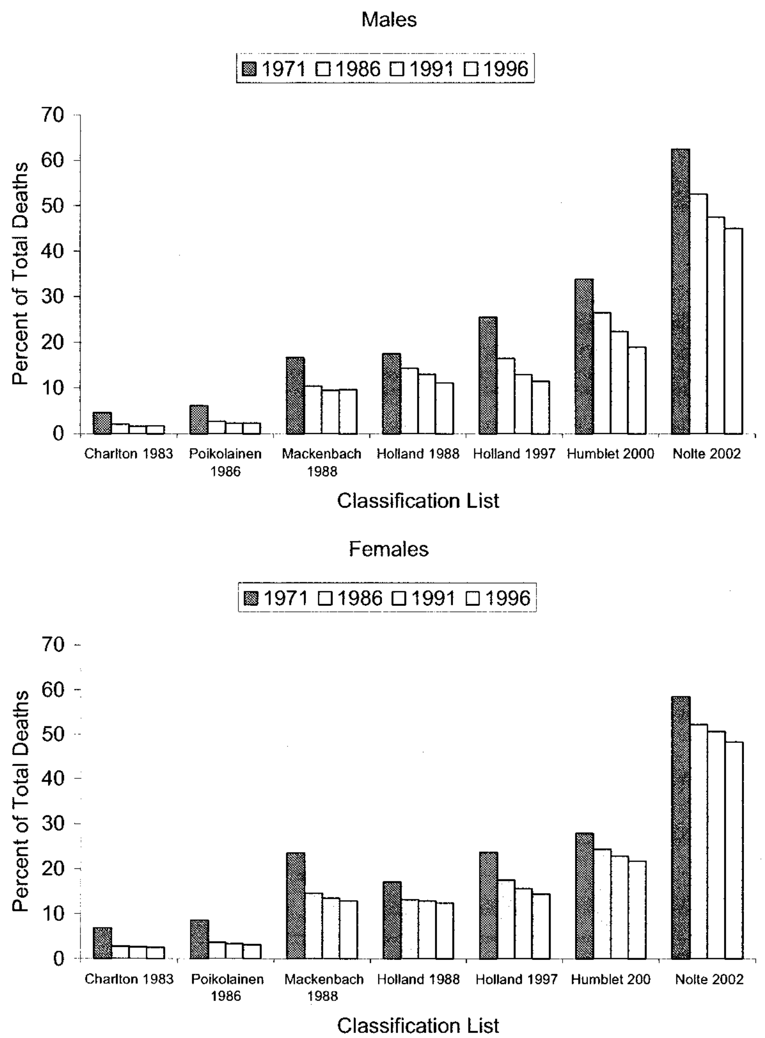

Figure 3.2: Proportion of all deaths under 75 years of age classified as 'avoidable', by 'avoidable' deaths classification lists, males and females, urban Canada, 1971 to 1996

Q5-Q1 'Avoidable' SEYLL Rate Difference Trends by Classification List

Table 3.4 presents the Q5-Q1 SEYLL RDs for each year considered. Figure 3.3 displays the Q5-Q1 avoidable SEYLL RDs for males and females comparing five of the classification lists that were considered.

Table 3.4: Q5-Q1 'Avoidable' SEYLL rate difference per 100,000 population, by 'avoidable' deaths classification list, by sex, urban Canada, 1971 to 1996

Causes	1971	1986	71-86 % Change*	1991	86-91 % Change	1996	91-96 % Change	71-96 % Change
Males								
Charlton 1983	980.7	387.6	-60.5	267.4	-31.0	306.5	14.6	-68.8
Poikolainen 1986	1335.0	507.4	-62.0	378.8	-25.3	373.0	-1.5	-72.1
Mackenbach 1988	2196.5	1142.6	-48.0	778.9	-31.8	840.9	8.0	-61.7
Holland 1988	1973.7	1231.7	-37.6	979.1	-20.5	700.1	-28.5	-64.5
Holland 1997	2337.9	1474.5	-36.9	999.9	-32.2	897.5	-10.2	-61.6
Humblet 2000	2783.5	1988.1	-28.6	1543.2	-22.4	944.0	-38.8	-66.1
Nolte 2002	5083.8	3383.5	-33.5	2656.1	-21.5	2107.6	-20.7	-58.5
Females								
Charlton 1983	980.7	327.2	-66.6	261.7	-20.0	174.3	-33.4	-82.2
Poikolainen 1986	1294.5	433.6	-66.5	328.0	-24.4	240.7	-26.6	-81.4
Mackenbach 1988	1501.8	750.2	-50.1	580.1	-22.7	398.8	-31.3	-73.5
Holland 1988	1348.1	607.5	-54.9	558.2	-8.1	370.9	-33.5	-72.5
Holland 1997	1586.2	599.9	-62.2	556.6	-7.2	496.1	-10.9	-68.7
Humblet 2000	1341.1	608.7	-54.6	651.4	7.0	579.0	-11.1	-56.8
Nolte 2002	2361.7	1350.2	-42.8	1270.7	-5.9	1030.6	-18.9	-56.4

Abbreviations: Q5-Q1: poorest quintile-richest quintile comparison,
SEYLL: age-standardized period expected years of life lost
* "-" indicates a decrease

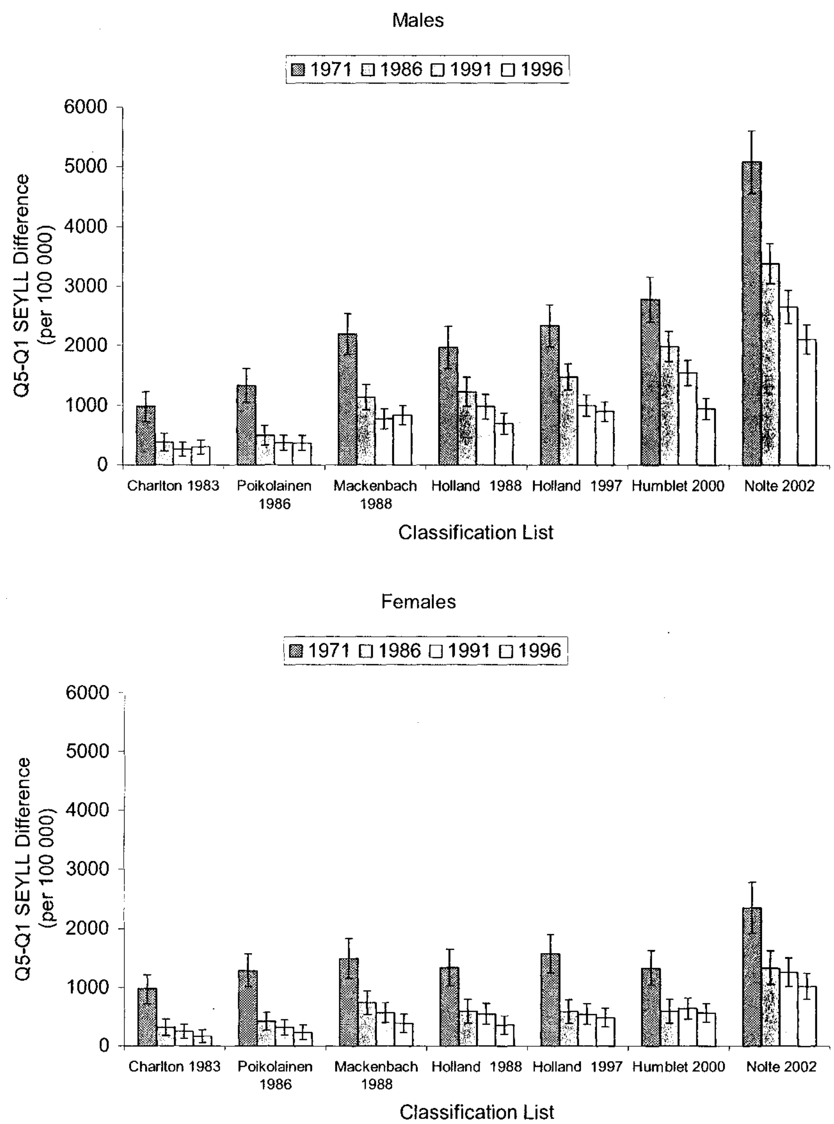

Figure 3.3: Q5-Q1 'Avoidable' SEYLL rate difference, by 'avoidable' deaths classification list, males and females, urban Canada, 1971 to 1996
Abbreviations: Q5-Q1: poorest quintile-richest quintile comparison,
SEYLL: age-standardized period expected years of life lost
Note: Bars represent the 95% confidence intervals

For both sexes, the Q5-Q1 avoidable SEYLL RDs decreased substantially from 1971 to 1996. However, the reductions in avoidable SEYLL RD between the years considered were not consistent between men or among the classification lists. For example, although all of the classification lists show a consistent reduction in the male avoidable SEYLL RDs from 1971 to

1991, the reductions from 1986 to 1991 were less apparent for women. The change in avoidable SEYLL RD in men from 1991 to 1996 were small and even led to an increase in avoidable SEYLL RDs according to some classification lists. Comparing Figure 3.2 with Figure 3.3, the classification lists that categorized a higher proportion of deaths as avoidable also (a) demonstrated larger avoidable SEYLL RDs and (b) showed greater reductions in avoidable SEYLL RDs over time. For all of the lists considered, the Q5-Q1 avoidable SEYLL RDs were greater in males than females.

3.2.2 Master List of Avoidable Deaths: Deaths Amenbable to Medical Intervention, Deaths Amenable to Public Health, Deaths from Ischaemic Heart Disease and Deaths from Other Causes

Table 3.5 and Figure 3.4 present the Q5-Q1 SEYLL RD trends for deaths amenable to medical intervention, deaths amenable to public health, deaths from ischaemic heart disease, and deaths from other causes, as classified using the "Master List" developed for this study.

Table 3.5: Q5-Q1 'Avoidable' SEYLL rate difference per 100,000 population, by cause category, by sex, urban Canada, 1971 to 1996

Cause Category	1971	1986	71-86 % Change*	1991	86-91 % Change	1996	91-96 % Change	71-96 % Change
Males								
Medical	2254.5	1235.3	-45.2	906.2	-26.7	870.3	-4.0	-61.4
Public health	1273.4	1010.8	-20.6	925.6	-8.4	521.0	-43.7	-59.1
Ischaemic heart disease	1800.2	1241.3	-31.1	939.1	-24.4	762.3	-18.8	-57.7
Other	3911.8	4217.9	7.8	4526.4	7.3	4224.7	-6.7	8.0
Females								
Medical	1674.1	730.1	-56.4	607.7	-16.8	363.0	-40.3	-78.3
Public health	269.4	260.5	-3.3	296.4	13.8	230.5	-22.2	-14.4
Ischaemic heart disease	694.6	442.2	-36.3	425.9	-3.7	430.2	1.0	-38.1
Other	1664.0	1428.6	-14.2	1448.2	1.4	1656.0	14.3	-0.5

Abbreviations: Q5-Q1: poorest quintile-richest quintile comparison,
SEYLL: age-standardized period expected years of life lost
* "-" indicates a decrease

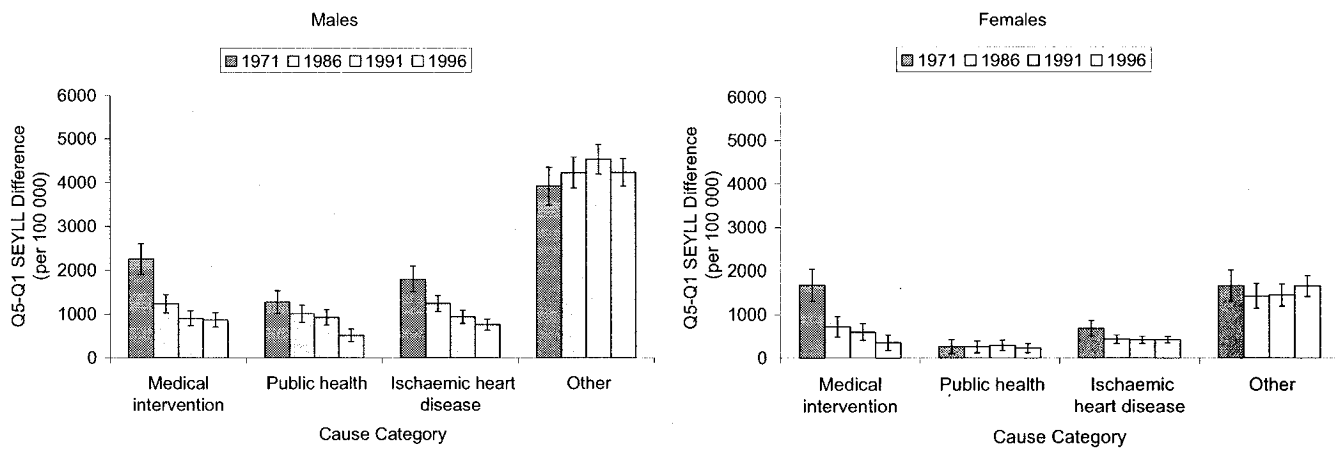

Figure 3.4: Q5-Q1 'Avoidable' SEYLL rate difference, by cause category, males and females, urban Canada, 1971 to 1996
Abbreviations: Q5-Q1: poorest quintile-richest quintile comparison,
SEYLL: age-standardized period expected years of life lost
Note: Bars represent the 95% confidence intervals

For males, Q5-Q1 SEYLL RDs related to deaths amenable to medical interventions decreased consistently from 1971 to 1991, but did not change from 1991 to 1996. Q5-Q1 SEYLL RDs related to deaths amenable to public health and ischaemic heart disease decreased notably from 1971 to 1996. This trend is not observed for deaths from other causes.

For females, Q5-Q1 SEYLL RDs related to deaths amenable to medical intervention decreased consistently from 1971 to 1996. The Q5-Q1 SEYLL RD related to deaths amenable to public health remained at the same level from 1971 to 1996. Years of life lost disparity related to deaths from ischaemic heart disease decreased from 1971 to 1986, but did not change afterwards. Q5-Q1 SEYLL RDs related to deaths from other causes did not change remarkably from 1971 to 1996.

3.4 Cause-Specific Contributions to All Cause QT-Q1 SEYLL Rate Difference

Tables 3.6 and 3.7 present the cause-specific contributions to QT-Q1 SEYLL RDs for males and females. The causes were ranked according to their contribution to QT-Q1 SEYLL RD in 1996. Ischaemic heart disease, lung cancer, perinatal mortality, and cerebrovascular disease contributed the most to absolute SEYLL disparity in 1996, together accounting for 32 and 37% of all cause QT-Q1 SEYLL RD for males and females, respectively.

Cirrhosis of the liver also contributed considerably to absolute all cause QT-Q1 disparity in males during the years considered, contributing approximately 4% to QT-Q1 SEYLL RD during 1996. In females, 1% QT-Q1 SEYLL RD was attributable to cirrhosis of the liver in 1996.

Other causes that contributed more than 1% to QT-Q1 SEYLL RD during 1996 were congenital cardiovascular anomalies and pneumonia for males, and neoplasm of the cervix uteri for females. From 1986 to 1996, SEYLL from breast cancer in females and motor vehicle accidents in males were increasingly greater in the richer quintiles thus contributing against the absolute QT-Q1 SEYLL disparity.

Tables 3.6 and 3.7 also note whether the causes of death were included in the avoidable deaths classification lists considered in this study. Each classification list included a different combination of avoidable causes. Further, each classification list included a different combination of the 4 causes that contributed the greatest to all cause QT-Q1 SEYLL RD in 1996.

Table 3.6: QT-Q1 'Avoidable' SEYLL rate difference per 100,000 population, by cause of death (age range in parentheses), males, urban Canada, 1971 to 1996

		QT-Q1 SEYLL RD		Included in Classification List?						
RANK†	Cause	RD	%§	Charlton 1983	Poikolainen 1986	Makcenbach 1988	Holland 1988	Holland 1997	Humblet 2000	Nolte 2002
1	*Ischaemic heart disease (35-74)*							Yes	Yes	Yes
	1971	724.32 *	18.21							
	1986	601.79 *	19.93							
	1991	414.22 *	15.41							
	1996	337.03 *	14.14							
2	*Lung cancer (0-74)*						Yes		Yes	Yes
	1971	226.85	5.70							
	1986	341.89 *	11.32							
	1991	253.14 *	9.42							
	1996	207.46 *	8.70							
3	*Perinatal conditions*			Yes	Yes	Yes	Yes	Yes		Yes
	1971	383.99 *	9.66							
	1986	107.45	3.56							
	1991	47.44	1.77							
	1996	136.42	5.72							
4	*Cirrhosis of the liver (0-74)*						Yes		Yes	Yes
	1971	208.62 *	5.25							
	1986	100.71 *	3.34							
	1991	110.55 *	4.11							
	1996	88.53 *	3.71							
5	*Cerebrovascular disease (35-74)*					Yes	Yes	Yes	Yes	Yes
	1971	75.10	1.89							
	1986	114.33 *	3.79							
	1991	79.94 *	2.97							
	1996	86.85 *	3.64							
6	*Congenital cardiovascular anomalies (0-74)*					Yes				Yes
	1971	81.77 *	2.06							
	1986	47.01	1.56							
	1991	21.06	0.78							
	1996	30.57	1.28							
7	*Pneumonia (0-74)*			Yes		Yes	Yes	Yes		Yes
	1971	157.68	3.97							
	1986	69.94 *	2.32							
	1991	60.00 *	2.23							
	1996	29.33	1.23							
8	*Emphysema (0-74)*				Yes		Yes	Yes		Yes
	1971	61.26	1.54							
	1986	26.91	0.89							
	1991	20.94	0.78							
	1996	7.78	0.33							
	Motor vehicle accidents ((0-74)						Yes		Yes	Yes
	1971	214.69	5.40							
	1986	-26.64	-0.88							
	1991	-59.52	-2.22							
	1996	-101.71 *	-4.27							
	Other 'avoidable' causes									
	1971	267.35	6.72							
	1986	151.60	5.02							
	1991	116.03	4.32							
	1996	61.33	2.57							

Abbreviations: QT-Q1: total population-richest quintile comparison,
SEYLL: age-standardized period expected years of life lost, RD: rate difference
*95 percent confidence interval does not include a zero value
†Ranked according to percent of all cause QT-Q1 SEYLL rate difference in 1996
§Percent of all cause QT-Q1 SEYLL RD
Note: This table also notes whether the cause of death is mentioned on any of the avoidable deaths classification lists considered in this study. The first author of the study and year of publication are used to indicate the lists. "Yes" denotes that the cause is included in the list.

Table 3.7: QT-Q1 'Avoidable' SEYLL rate difference per 100,000 population, by cause of death (age ranges in parentheses), females, urban Canada, 1971 to 1996

		QT-Q1 SEYLL RD		Included in Classification List?						
RANK	Cause	RD	%	Charlton 1983	Poikolainen 1986	Mackenbach 1988	Holland 1988	Holland 1997	Humblet 2000	Nolte 2002
1	*Ischaemic heart disease (35-74)*							Yes	Yes	Yes
	1971	291.77 *	15.45							
	1986	197.57 *	19.03							
	1991	175.67 *	17.59							
	1996	164.22 *	15.95							
2	*Lung cancer (0-74)*						Yes		Yes	Yes
	1971	30.40	1.61							
	1986	104.45	10.06							
	1991	86.99	8.71							
	1996	112.49 *	10.92							
3	*Perinatal conditions*			Yes	Yes	Yes	Yes	Yes		Yes
	1971	219.49 *	11.62							
	1986	75.03	7.23							
	1991	29.76	2.98							
	1996	65.09	6.32							
4	*Cerebrovascular disease (35-74)*					Yes	Yes	Yes	Yes	Yes
	1971	37.32	1.98							
	1986	56.03	5.40							
	1991	25.93	2.60							
	1996	43.76	4.25							
5	*Cervical cancer (15-74)*			Yes	Yes	Yes	Yes	Yes	Yes	Yes
	1971	87.42	4.63							
	1986	37.43	3.61							
	1991	17.10	1.71							
	1996	14.90	1.45							
6	*Cirrhosis of the liver (0-74)*						Yes		Yes	Yes
	1971	75.72	4.01							
	1986	36.78	3.54							
	1991	43.69	4.38							
	1996	12.12	1.18							
7	*Motor vehicle accidents (0-74)*						Yes		Yes	Yes
	1971	60.53	3.21							
	1986	-72.66	-7.00							
	1991	-21.17	-2.12							
	1996	10.64	1.03							
8	*Uterine cancer (15-74)*						Yes	Yes	Yes	
	1971	40.41	2.14							
	1986	8.35	0.80							
	1991	11.17	1.12							
	1996	10.28	1.00							
9	*Chronic rheumatic heart disease (0-74)*			Yes			Yes	Yes	Yes	Yes
	1971	34.45	1.82							
	1986	8.61	0.83							
	1991	12.89	1.29							
	1996	8.17	0.79							
10	*Pneumonia (0-74)*			Yes		Yes	Yes	Yes		Yes
	1971	99.48	5.27							
	1986	38.09	3.67							
	1991	18.82	1.89							
	1996	7.98	0.78							
	Congenital cardiovascular anomalies (0-74)					Yes				Yes
	1971	13.22	0.70							
	1986	14.71	1.42							
	1991	28.00	2.80							
	1996	-11.96	-1.16							
	Breast cancer (25-74)							Yes	Yes	Yes
	1971	-33.59	-1.78							
	1986	-18.01	-1.74							
	1991	-28.80	-2.88							
	1996	-52.49	-5.10							
	Other 'avoidable' causes									
	1971	190.47	6.96							
	1986	42.95	2.69							
	1991	42.70	2.89							
	1996	47.47	3.24							

Abbreviations: QT-Q1: total population-richest quintile comparison,
SEYLL: age-standardized period expected years of life lost, RD: rate difference
*95 percent confidence interval does not include a zero value
†Ranked according to percent of all cause QT-Q1 SEYLL rate difference in 1996
§Percent of all cause QT-Q1 SEYLL RD

Note: This table also notes whether the cause of death is motioned on any of the avoidable deaths classification lists considered in this study. The first author of the study and year of publication are used to indicate the lists. "Yes" denotes that the cause is included in the list.

3.5 Cause-Specific Trends

This section presents cause-specific avoidable SEYLL rate trends, by neighbourhood income quintile, for those causes that contributed 1% or more to QT-Q1 SEYLL RD in urban Canada in 1996. Table 3.8 presents the Q5-Q1 and QT-Q1 SEYLL RRs and RDs by cause. Figure 3.5 displays SEYLL rate trends, by neighbourhood income quintile, for each cause.

In general, SEYLL disparity related to these causes decreased notably over time. For example, from 1971 to 1996, Q5-Q1 SEYLL RDs related to deaths from ischaemic heart disease in males decreased 57.7% and Q5-Q1 SEYLL RDs related to deaths from cervical cancer in females decreased 82.6%.

However, there are exceptions to this trend. For some conditions, SEYLL disparities have not changed remarkably over time. For example, Q5-Q1 SEYLL RDs related to deaths from lung cancer in males decreased 5.4% from 1971 to 1996. From 1986 to 1991, Q5-Q1 SEYLL RDs related to deaths from ischaemic heart disease in females decreased 2.7%. For other conditions, SEYLL inequalities have widened over time. For example, Q5-Q1 SEYLL RDs for death related to lung cancer in females increased 272.0% from 1971 to 1996. From 1991 to 1996, Q5-Q1 SEYLL RDs related to deaths from perinatal conditions in males increased 78.4%.

Table 3.8: 'Avoidable' SEYLL rate ratio and rate difference per 100,000 population, by cause of death (age range in parentheses), Q5-Q1 and QT-Q1, by sex, urban Canada, 1971 to 1996

		Q5-Q1				QT-Q1		
Year	n	RR	95%CI	RD	95%CI	RR*	RD	95%CI
				Ischaemic heart disease (35-74)				
Males								
1971	9,573	1.49	(1.39 , 1.59)	1800.19	(1,506.51 , 2,093.87)	1.20	724.32	(241.14 , 1,207.50)
1986	8,488	1.65	(1.53 , 1.78)	1241.25	(1,061.01 , 1,421.49)	1.32	601.79	(348.82 , 854.76)
1991	6,985	1.68	(1.55 , 1.83)	939.07	(795.01 , 1,083.13)	1.30	414.22	(219.90 , 608.55)
1996	6,609	1.66	(1.53 , 1.80)	762.31	(640.12 , 884.49)	1.29	337.03	(185.58 , 488.49)
Females								
1971	3,675	1.56	(1.39 , 1.75)	694.58	(522.26 , 866.91)	1.23	291.77	(-19.15 , 602.70)
1986	3,435	1.65	(1.46 , 1.86)	442.20	(339.49 , 544.90)	1.29	197.57	(25.61 , 369.53)
1991	2,882	1.87	(1.64 , 2.14)	425.87	(338.83 , 512.90)	1.36	175.67	(35.62 , 315.72)
1996	2,557	2.15	(1.87 , 2.47)	430.23	(354.96 , 505.50)	1.44	164.22	(58.88 , 269.56)
				Lung cancer (0-74)				
Males								
1971	2,158	1.71	(1.48 , 1.98)	533.18	(397.13 , 669.22)	1.30	226.85	(-4.94 , 458.64)
1986	3,520	2.11	(1.87 , 2.37)	762.30	(646.51 , 878.08)	1.50	341.88	(179.18 , 504.58)
1991	3,722	1.95	(1.75 , 2.18)	663.04	(556.29 , 769.79)	1.36	253.14	(110.83 , 395.44)
1996	3,659	1.83	(1.64 , 2.04)	504.52	(413.94 , 595.09)	1.34	207.46	(94.96 , 319.96)
Females								
1971	392	1.33	(0.94 , 1.88)	55.28	(-11.89 , 122.45)	1.18	30.40	(-75.53 , 136.34)
1986	1,477	1.62	(1.35 , 1.94)	221.23	(139.72 , 302.73)	1.29	104.45	(-18.02 , 226.91)
1991	1,956	1.43	(1.23 , 1.68)	190.59	(109.52 , 271.66)	1.20	86.99	(-35.54 , 209.52)
1996	2,332	1.45	(1.25 , 1.66)	205.63	(127.11 , 284.15)	1.24	112.49	(3.45 , 221.52)
				Perinatal conditions				
Males								
1971	921	1.90	(1.52 , 2.38)	667.72	(441.34 , 894.11)	1.52	383.99	(45.33 , 722.64)
1986	432	1.70	(1.26 , 2.30)	252.60	(111.22 , 393.99)	1.30	107.45	(-72.03 , 286.92)
1991	329	1.53	(1.10 , 2.14)	140.50	(31.32 , 249.68)	1.18	47.44	(-88.02 , 182.89)
1996	345	2.23	(1.55 , 3.22)	250.68	(142.67 , 358.70)	1.67	136.42	(-16.02 , 288.86)
Females								
1971	620	1.87	(1.44 , 2.43)	540.06	(324.55 , 755.56)	1.36	219.49	(-88.23 , 527.21)
1986	284	1.70	(1.17 , 2.47)	185.88	(57.69 , 314.08)	1.28	75.03	(-88.64 , 238.70)
1991	245	1.63	(1.12 , 2.37)	142.99	(33.84 , 252.13)	1.13	29.75	(-99.66 , 159.17)
1996	248	1.61	(1.08 , 2.41)	125.39	(22.84 , 227.93)	1.32	65.09	(-75.44 , 205.61)
				Cerebrovascular disease (35-74)				
Males								
1971	1,523	1.35	(1.14 , 1.60)	212.64	(97.68 , 327.61)	1.12	75.10	(-123.02 , 273.22)
1986	1,219	2.22	(1.82 , 2.70)	292.01	(221.08 , 362.94)	1.48	114.33	(18.00 , 210.66)
1991	1,130	2.06	(1.68 , 2.53)	215.81	(155.98 , 275.65)	1.39	79.94	(1.87 , 158.01)
1996	1,122	2.32	(1.89 , 2.85)	205.36	(155.73 , 254.99)	1.56	86.85	(25.41 , 148.29)
Females								
1971	1,302	1.20	(1.00 , 1.45)	110.56	(-1.44 , 222.55)	1.07	37.32	(-148.65 , 223.30)
1986	1,047	1.51	(1.22 , 1.87)	124.77	(61.98 , 187.57)	1.23	56.03	(-42.75 , 154.80)
1991	939	1.52	(1.22 , 1.90)	109.72	(52.06 , 167.37)	1.12	25.93	(-55.97 , 107.84)
1996	970	1.56	(1.25 , 1.95)	96.23	(48.06 , 144.39)	1.26	43.76	(-21.83 , 109.35)
				Cirrhosis of the liver (0-74)				
Males								
1971	733	4.15	(3.13 , 5.51)	572.37	(469.46 , 675.28)	2.15	208.62	(72.77 , 344.48)
1986	829	2.75	(2.16 , 3.49)	315.45	(242.50 , 388.41)	1.56	100.71	(14.65 , 186.78)
1991	808	3.65	(2.84 , 4.67)	332.90	(270.02 , 395.77)	1.88	110.55	(37.47 , 183.63)
1996	775	3.17	(2.48 , 4.06)	239.66	(188.22 , 291.10)	1.80	88.53	(29.86 , 147.20)
Females								
1971	359	2.84	(1.94 , 4.16)	236.09	(154.18 , 318.00)	1.59	75.72	(-30.34 , 181.78)
1986	364	2.05	(1.42 , 2.97)	92.90	(45.04 , 140.76)	1.42	36.78	(-27.54 , 101.10)
1991	338	3.19	(2.11 , 4.81)	134.59	(88.79 , 180.39)	1.71	43.69	(-12.35 , 99.72)
1996	275	1.35	(0.90 , 2.03)	22.03	(-8.39 , 52.44)	1.19	12.12	(-29.63 , 53.87)

Abbreviations: SEYLL: age-standardized period expected years of life lost, n: number of deaths, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, n: number of deaths, RR: rate ratio, RD: rate difference, 95%CI: 95% confidence interval
*Confidence interval for QT-Q1 RR not available

Table 3.8: 'Avoidable' SEYLL rate ratio and rate difference per 100,000 population by cause of death (age range in parentheses), Q5-Q1 and QT-Q1, by sex, urban Canada, 1971 to 1996 (continued)

		Q5-Q1				QT-Q1		
Year	n	RR	95%CI	RD	95%CI	RR*	RD	95%CI
				Motor vehicle accidents (0-74)				
Males								
1971	1,482	1.17	(0.97 , 1.40)	167.86	(-26.58 , 362.30)	1.21	214.69	(-84.27 , 513.64)
1986	1,109	0.91	(0.74 , 1.11)	-66.97	(-203.42 , 69.49)	0.96	-26.64	(-217.26 , 163.97)
1991	953	0.88	(0.72 , 1.09)	-70.37	(-190.20 , 49.46)	0.90	-59.52	(-226.78 , 107.73)
1996	759	0.56	(0.43 , 0.72)	-223.19	(-322.32 , -124.06)	0.80	-101.71	(-241.60 , 38.19)
Females								
1971	611	0.95	(0.71 , 1.27)	-21.95	(-150.97 , 107.07)	1.13	60.53	(-132.39 , 253.45)
1986	470	0.85	(0.64 , 1.15)	-53.60	(-155.04 , 47.84)	0.80	-72.66	(-200.16 , 54.84)
1991	400	0.89	(0.63 , 1.24)	-28.83	(-109.06 , 51.39)	0.92	-21.17	(-127.80 , 85.45)
1996	317	1.02	(0.68 , 1.51)	2.86	(-63.07 , 68.80)	1.06	10.64	(-79.44 , 100.71)
				Breast cancer (25-74)				
Females								
1971	1,301	0.94	(0.78 , 1.14)	-41.14	(-174.18 , 91.91)	0.95	-33.59	(-229.01 , 161.83)
1986	1,903	0.96	(0.82 , 1.13)	-25.46	(-134.79 , 83.87)	0.97	-18.01	(-166.42 , 130.39)
1991	1,937	0.99	(0.85 , 1.16)	-3.81	(-102.07 , 94.46)	0.96	-28.80	(-159.22 , 101.62)
1996	2,042	0.93	(0.81 , 1.08)	-42.71	(-130.18 , 44.76)	0.92	-52.49	(-163.53 , 58.55)
				Congenital cardiovascular anomalies (0-74)				
Males								
1971	215	1.87	(1.16 , 3.02)	134.39	(35.35 , 233.42)	1.53	81.77	(-64.24 , 227.79)
1986	186	1.71	(1.05 , 2.79)	91.81	(8.92 , 174.70)	1.36	47.01	(-59.59 , 153.61)
1991	158	1.29	(0.77 , 2.16)	32.77	(-33.57 , 99.11)	1.19	21.06	(-63.57 , 105.70)
1996	134	2.01	(1.11 , 3.64)	74.19	(13.73 , 134.64)	1.42	30.57	(-47.58 , 108.72)
Females								
1971	178	1.16	(0.72 , 1.88)	32.21	(-70.66 , 135.07)	1.07	13.22	(-131.95 , 158.38)
1986	165	1.28	(0.79 , 2.09)	46.13	(-43.43 , 135.70)	1.09	14.71	(-98.47 , 127.90)
1991	117	1.43	(0.76 , 2.67)	34.95	(-26.69 , 96.59)	1.34	28.00	(-54.30 , 110.30)
1996	104	0.99	(0.55 , 1.80)	-0.81	(-60.62 , 59.01)	0.88	-11.96	(-87.48 , 63.56)
				Cervical cancer (15-74)				
Females								
1971	279	3.31	(2.08 , 5.26)	191.81	(119.56 , 264.06)	2.05	87.42	(-9.86 , 184.70)
1986	206	3.00	(1.76 , 5.09)	84.32	(45.86 , 122.78)	1.89	37.43	(-15.88 , 90.74)
1991	198	2.25	(1.41 , 3.58)	69.78	(29.66 , 109.89)	1.31	17.10	(-29.09 , 63.29)
1996	187	1.72	(1.03 , 2.85)	33.47	(2.65 , 64.30)	1.32	14.90	(-24.80 , 54.60)
				Pneumonia (0-74)				
Males								
1971	589	2.98	(2.16 , 4.10)	411.54	(303.72 , 519.37)	1.76	157.68	(-3.65 , 319.02)
1986	428	3.52	(2.43 , 5.11)	175.56	(125.06 , 226.06)	2.00	69.94	(1.93 , 137.94)
1991	382	4.10	(2.60 , 6.47)	147.31	(105.43 , 189.18)	2.26	60.00	(5.85 , 114.15)
1996	428	2.43	(1.67 , 3.53)	119.01	(72.71 , 165.32)	1.35	29.33	(-23.30 , 81.96)
Females								
1971	348	2.28	(1.51 , 3.45)	209.72	(107.86 , 311.58)	1.61	99.48	(-46.70 , 245.67)
1986	253	3.35	(2.11 , 5.32)	115.57	(66.08 , 165.06)	1.77	38.09	(-23.50 , 99.68)
1991	235	2.05	(1.30 , 3.23)	53.50	(18.63 , 88.36)	1.37	18.82	(-31.27 , 68.91)
1996	246	1.56	(0.92 , 2.66)	33.91	(-5.59 , 73.41)	1.13	7.98	(-37.47 , 53.43)

Abbreviations: SEYLL: age-standardized period expected years of life lost, n: number of deaths, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, n: number of deaths, RR: rate ratio, RD: rate difference, 95%CI: 95% confidence interval
*Confidence interval for QT-Q1 RR not available

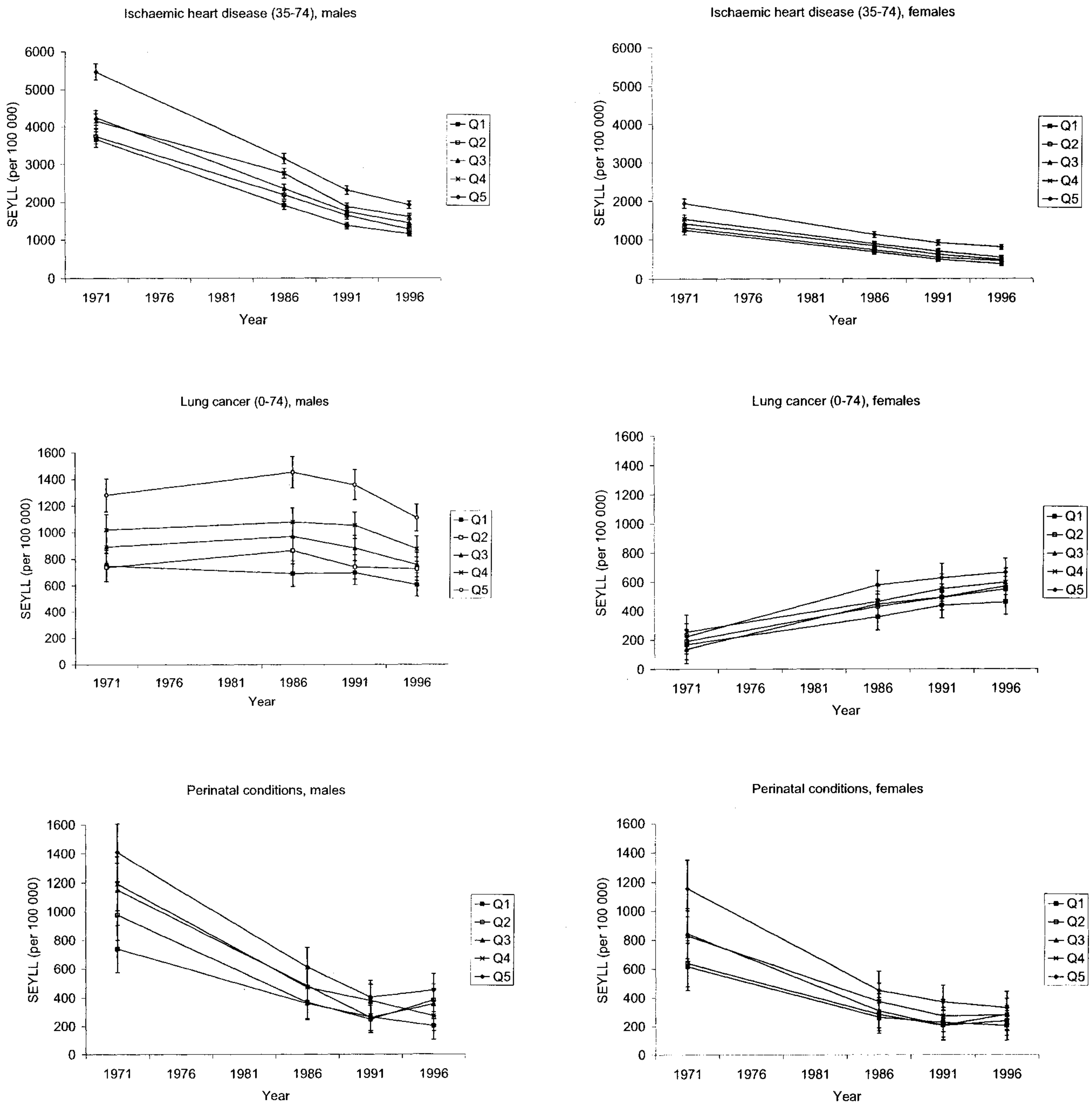

Figure 3.5: 'Avoidable' SEYLL rate, by neighbourhood income quintile, by cause of death (age range in parentheses), males and females, urban Canada, 1971 to 1996

Abbreviations: SEYLL: age-standardized period expected years of life lost, Q1: richest quintile, Q5: poorest quintile

Note: Bars represent the 95% confidence intervals

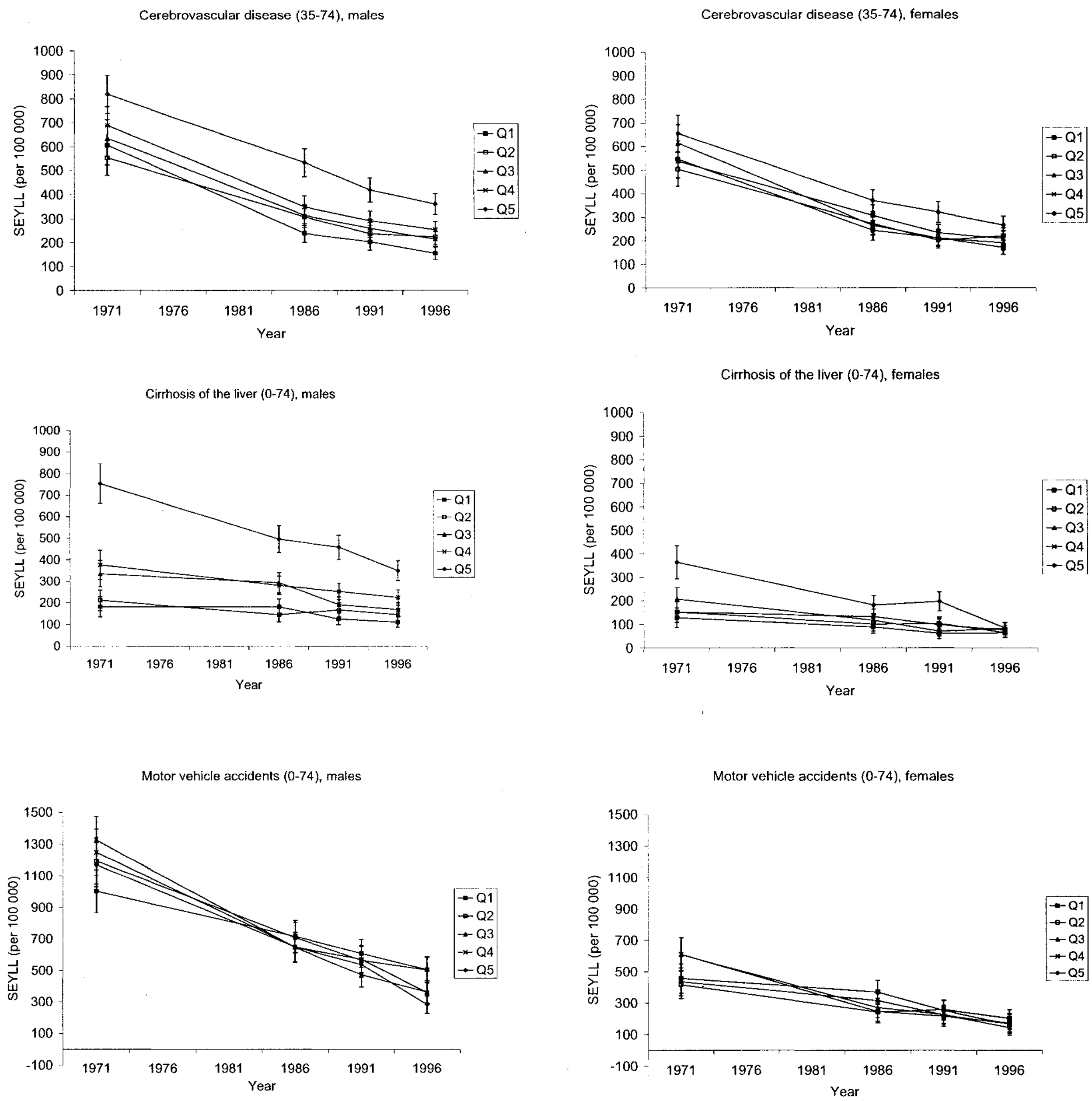

Figure 3.5: 'Avoidable' SEYLL rate, by neighbourhood income quintile, by cause of death (age range in parentheses), males and females, urban Canada, 1971 to 1996 (continued)
Abbreviations: SEYLL: age-standardized period expected years of life lost,
Q1: richest quintile, Q5: poorest quintile
Note: Bars represent the 95% confidence intervals

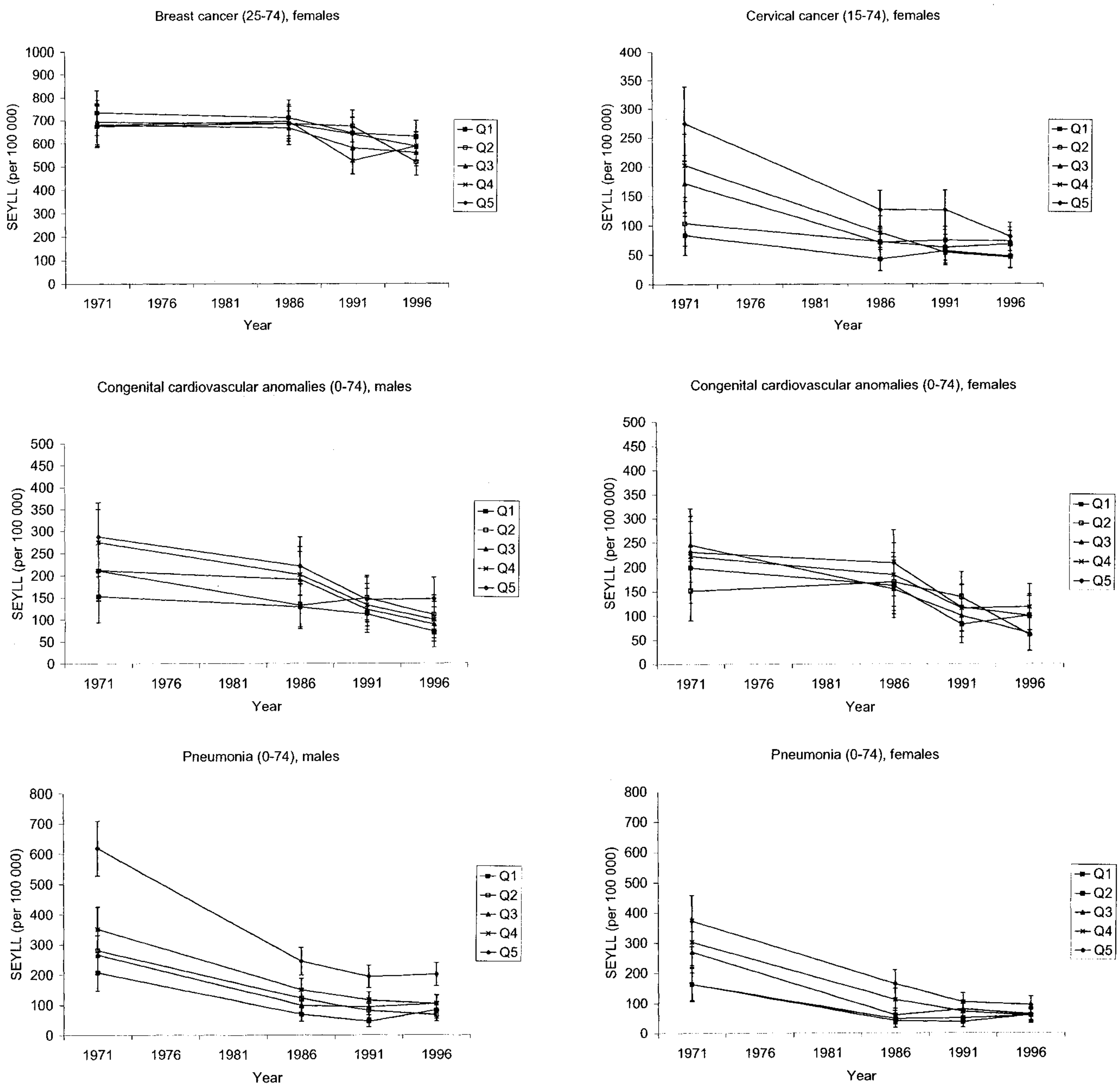

Figure 3.5: 'Avoidable' SEYLL rate, by neighbourhood income quintile, by cause of death (age range in parentheses), males and females, urban Canada, 1971 to 1996 (continued)

Abbreviations: SEYLL: age-standardized period expected years of life lost,

Q1: richest quintile, Q5: poorest quintile

Note: Bars represent the 95% confidence intervals

3.6 Sensitivity Analysis

Cause-specific contribution to QT-Q1 mortality difference, by mortality indicator

Tables 3.9 and 3.10 present the contribution of 'avoidable' causes to QT-Q1 differences in (a) crude and age-standardized period expected years of life lost (EYLL and SEYLL) rates; (b) crude and age-standardized potential years of life lost (PYLL and SPYLL) rates; and (c) age-standardized mortality rate (ASMR) for males and females. The causes are ranked according to their contribution to QT-Q1 mortality rate difference in 1996. As expected, EYLL demonstrated larger QT-Q1 years of life lost RD compared to PYLL. Age-standardizing EYLL and PYLL reduced the observed absolute QT-Q1 years of life lost disparity. The proportion of all cause QT-Q1 years of life lost RD attributed to each cause of death is generally greater when considering EYLL compared to PYLL. One notable exception was perinatal conditions. Computing PYLL increased the contribution of perinatal conditions to all cause QT-Q1 years of life lost RD.

For males, the cause-specific contributions to all cause mortality disparity in 1996 did not change substantially between years of life lost calculations. The percent contribution of the causes that did change rankings were similar. For females, although the 1996 rankings for some causes varied between the years of life lost indicators, the top six causes that contributed to mortality disparity were the same for all years of life lost methods.

The contributions of the some causes were different when considering ASMR compared to years of life lost calculations. The conditions for which deaths were likely to occur at younger ages (for example, perinatal conditions and cirrhosis of the liver) contributed more to absolute years of life lost disparity than ASMR disparity.

In 1996, Ischaemic heart disease, lung cancer, perinatal mortality, cirrhosis of the liver (for males only), and cerebrovacular disease contributed the greatest to all cause QT-Q1 absolute mortality disparity, regardless of how mortality was assessed.

Table 3.9: QT-Q1 'Avoidable' mortality rate difference per 100,000 population, by mortality indicator, by cause of death (age range in parentheses), males, urban Canada, 1971 to 1996

	SEYLL			EYLL			SPYLL			PYLL			ASMR		
Year	Rank	RD	%	Rank	RD	%	Rank	RD	%	Rank	RD	%	Rank	RD	%
Ischaemic heart disease (35-74)	1			1			1			1			1		
1971		724.32 *	18.21		979.22 *	20.72		468.71 *	15.48		564.39 *	16.36		35.91 *	24.71
1986		601.79 *	19.93		691.80 *	20.15		378.71 *	17.22		395.13 *	16.65		31.00 *	25.30
1991		414.22 *	15.41		513.48 *	16.19		257.95 *	13.51		288.22 *	13.35		21.55 *	18.98
1996		337.03 *	14.14		384.27 *	13.64		207.32 *	11.64		213.78 *	10.58		17.68 *	18.95
Lung cancer (0-74)	2			2			2			2			2		
1971		226.85	5.70		257.72 *	5.45		125.93	4.16		142.83 *	4.14		13.00 *	8.94
1986		341.89 *	11.32		362.20 *	10.55		200.04 *	9.09		208.11 *	8.77		18.89 *	15.42
1991		253.14 *	9.42		300.78 *	9.48		154.23 *	8.08		169.35 *	7.85		13.73 *	12.09
1996		207.46 *	8.70		245.65 *	8.72		137.98 *	7.75		149.98 *	7.42		10.14 *	10.86
Perinatal conditions	3			3			3			3			5		
1971		383.99 *	9.66		506.81 *	10.73		368.63 *	12.17		486.54 *	14.10		4.92 *	3.39
1986		107.45	3.56		105.76	3.08		103.17	4.69		101.55	4.28		1.38	1.12
1991		47.44	1.77		54.13	1.71		45.63	2.39		52.03	2.41		0.59	0.52
1996		136.42	5.72		144.04 *	5.11		130.96	7.35		138.27 *	6.84		1.76 *	1.88
Cirrhosis of the liver (0-74)	4			5			4			4			3		
1971		208.62 *	5.25		180.94 *	3.83		150.15 *	4.96		133.27 *	3.86		8.81 *	6.06
1986		100.71 *	3.34		104.38 *	3.04		74.29 *	3.38		74.03 *	3.12		4.24 *	3.46
1991		110.55 *	4.11		115.57 *	3.64		79.12 *	4.14		81.70 *	3.79		4.73 *	4.16
1996		88.53 *	3.71		92.47 *	3.28		64.11 *	3.60		65.46 *	3.24		3.74 *	4.01
Cerebrovascular disease (35-74)	5						5			5			4		
1971		75.10	1.89	4	127.99	2.71		42.57	1.41		60.37	1.75		4.18	2.87
1986		114.33 *	3.79		127.86 *	3.72		73.92 *	3.36		75.68 *	3.19		5.71 *	4.66
1991		79.94 *	2.97		91.85 *	2.90		46.44 *	2.43		48.09 *	2.23		4.45 *	3.92
1996		86.85 *	3.64		97.51 *	3.46		52.69 *	2.96		56.29 *	2.79		4.61 *	4.94
Congenital cardiovascular anomalies (0-74)	6			7			6			6			8		
1971		81.77 *	2.06		97.68	2.07		77.22	2.55		92.88	2.69		1.22	0.84
1986		47.01	1.56		48.96	1.43		44.20	2.01		46.00	1.94		0.74	0.61
1991		21.06	0.78		17.59	0.55		19.86	1.04		16.75	0.78		0.30	0.27
1996		30.57	1.28		33.71	1.20		28.47	1.60		31.38	1.55		0.53	0.56
Pneumonia (0-74)	7			6			7			7			6		
1971		157.68	3.97		165.31 *	3.50		120.38	3.98		128.64	3.73		5.54 *	3.81
1986		69.94 *	2.32		74.34 *	2.17		50.62 *	2.30		52.00 *	2.19		2.86 *	2.34
1991		60.00 *	2.23		59.66 *	1.88		35.19	1.84		35.62	1.65		3.20 *	2.82
1996		29.33	1.23		39.72	1.41		19.23	1.08		26.19	1.30		1.49	1.60
Emphysema (0-74)	8			8			8			8			9		
1971		61.26	1.54		64.01	1.36		35.80	1.18		37.00	1.07		3.36 *	2.31
1986		26.91	0.89		26.18	0.76		12.89	0.59		12.93	0.55		1.71 *	1.40
1991		20.94	0.78		23.47	0.74		11.85	0.62		12.67	0.59		1.21	1.07
1996		7.78	0.33		10.01	0.36		4.61	0.26		5.52	0.27		0.42	0.45
Motor vehicle accidents ((0-74)	9			9			9			9			12		
1971		214.69	5.40		266.33	5.64		196.28	6.48		238.98	6.93		4.52 *	3.11
1986		-26.64	-0.88		13.91	0.41		-30.05	-1.37		7.55	0.32		0.08	0.06
1991		-59.52	-2.22		-24.17	-0.76		-50.73	-2.66		-19.73	-0.91		-1.67	-1.48
1996		-101.71 *	-4.27		-64.30	-2.28		-96.37	-5.41		-62.85 *	-3.11		-1.55	-1.66
Nephritis and nephrosis (0-74)	‡			‡			‡			‡			7		
1971														1.17	0.81
1986														1.71 *	1.40
1991														1.54 *	1.35
1996														0.60	0.65
Peptic ulcer (0-74)	‡			‡			‡			‡			10		
1971														2.24	1.54
1986														1.00	0.82
1991														0.55	0.48
1996														0.26	0.28

Abbreviations: SEYLL: age-standardized period expected years of life lost,
EYLL: period expected years of life lost, SPYLL: age-standardized potential years of life lost,
PYLL: potential years of life lost, ASMR: age-standardized mortality rate, RD: rate difference
*95% confidence interval does not include a zero value
†Ranked according to percent of all cause QT-Q1 (mortality indicator) RD in 1996
§Percent of all cause QT-Q1 (mortality indicator) RD
‡This cause did not contribute at least 1%

Table 3.10: QT-Q1 'Avoidable' SEYLL rate difference per 100,000 population, by mortality indicator, by cause of death (age range in parentheses), females, urban Canada, 1971 to 1996

	SEYLL			EYLL			SPYLL			PYLL			ASMR		
Year	Rank	RD	%	Rank	RD	%	Rank	RD	%	Rank	RD	%	Rank	RD	%
Ischaemic heart disease (35-74)	1			1			1			1			1		
1971		291.77	15.45		528.65 *	19.46		155.18 *	10.87		240.33 *	13.74		13.18 *	26.35
1986		197.57 *	19.03		356.35 *	21.63		98.51 *	14.26		147.15 *	17.63		9.43 *	26.37
1991		175.67 *	17.59		304.13 *	18.32		90.19 *	13.75		129.51 *	15.23		8.23 *	23.49
1996		164.22 *	15.95		246.40 *	16.62		91.59 *	12.96		116.98 *	14.21		7.17 *	21.28
Lung cancer (0-74)	2			2			2			2			2		
1971		30.40	1.61		46.34	1.71		19.41	1.36		25.80	1.48		1.07	2.14
1986		104.45	10.06		149.87 *	9.10		61.62	8.92		75.24 *	9.01		4.33 *	12.11
1991		86.99	8.71		164.71 *	9.92		52.95	8.07		78.78 *	9.26		3.50 *	10.00
1996		112.49 *	10.92		161.91 *	10.92		61.57	8.71		75.08 *	9.12		4.96 *	14.73
Perinatal conditions	3			4			3			3			4		
1971		219.49 *	11.62		282.71	10.41		199.85	14.00		257.42	14.71		2.67	5.34
1986		75.03	7.23		64.71	3.93		68.32	9.89		58.92	7.06		0.91	2.55
1991		29.76	2.98		26.35	1.59		27.10	4.13		24.00	2.82		0.36	1.03
1996		65.09	6.32		64.91	4.38		59.24	8.38		59.08	7.17		0.80	2.36
Cerebrovascular disease (35-74)	4			3			4			4			3		
1971		37.32	1.98		128.32	4.72		34.30	2.40		59.81	3.42		0.63 *	1.26
1986		56.03	5.40		93.96	5.70		30.88	4.47		39.50	4.73		2.48	6.93
1991		25.93	2.60		61.50	3.71		13.33	2.03		21.19	2.49		1.22	3.49
1996		43.76	4.25		66.95	4.52		23.04	3.26		26.89	3.27		2.00	5.93
Cervical cancer (15-74)	5			6			6			6			8		
1971		87.42	4.63		81.28	2.99		65.82	4.61		56.93	3.25		2.48	4.95
1986		37.43	3.61		42.12	2.56		27.16	3.93		28.71	3.44		1.13	3.16
1991		17.10	1.71		17.81	1.07		11.55	1.76		10.42	1.23		0.58	1.66
1996		14.90	1.45		18.26	1.23		11.23	1.59		12.73	1.55		0.42	1.25
Cirrhosis of the liver (0-74)	6			5			5			5			10		
1971		75.72	4.01		77.57	2.86		49.77	3.49		49.58	2.83		2.66	5.33
1986		36.78	3.54		44.81	2.72		24.21	3.51		26.42	3.17		1.29	3.60
1991		43.69	4.38		53.13	3.20		26.99	4.12		31.28	3.68		1.68	4.80
1996		12.12	1.18		18.88	1.27		11.53	1.63		13.41	1.63		0.17	0.49
Motor vehicle accidents (0-74)	7			10			7			10			9		
1971		60.53	3.21		88.48	3.26		50.08	3.51		71.64	4.10		1.24	2.48
1986		-72.66	-7.00		-72.42	-4.40		-66.31	-9.60		-69.11	-8.28		-0.86	-2.41
1991		-21.17	-2.12		-8.44	-0.51		-13.56	-2.07		-6.29	-0.74		-0.74	-2.11
1996		10.64	1.03		6.34	0.43		8.40	1.19		3.97	0.48		0.26	0.77
Uterine cancer (15-74)	8			9			8			9			6		
1971		40.41 #	2.14		43.74	1.61		24.57	1.72		25.22	1.44		1.60 *	3.19
1986		8.35 #	0.80		17.34	1.05		5.24	0.76		8.40	1.01		0.32	0.89
1991		11.17 #	1.12		18.41	1.11		7.33	1.12		9.31	1.10		0.40	1.15
1996		10.28 #	1.00		13.78	0.93		5.20	0.74		5.46	0.66		0.50	1.49
Chronic rheumatic heart disease (0-74)	9			8			9			7			7		
1971		34.45	1.82		51.06	1.88		32.81	2.30		35.99	2.06		0.45 *	0.90
1986		8.61	0.83		14.59	0.89		6.99	1.01		8.87	1.06		0.22	0.61
1991		12.89	1.29		15.78	0.95		6.43	0.98		7.33	0.86		0.61	1.75
1996		8.17	0.79		13.60	0.92		3.64	0.52		6.62	0.80		0.43	1.26
Pneumonia (0-74)	10			7			10			8			5		
1971		99.48	5.27		116.07	4.27		82.37	5.77		91.78	5.25		2.01 *	4.02
1986		38.09	3.67		48.62	2.95		32.85	4.76		34.97	4.19		0.69	1.93
1991		18.82	1.89		30.45	1.83		17.19	2.62		21.00	2.47		0.24 *	0.69
1996		7.98	0.78		17.72	1.20		2.53	0.36		7.04	0.86		0.52	1.54
Congenital cardiovascular anomalies (0-74)													‡		
1971		13.22	0.70		13.63	0.96		13.63	0.96		23.46	1.34			
1986		14.71	1.42		13.65	1.98		13.65	1.98		6.93	0.83			
1991		28.00	2.80		26.47	4.04		26.47	4.04		24.82	2.92			
1996		-11.96	-1.16		-10.40	-1.47		-10.40	-1.47		-7.49	-0.91			
Breast Cancer (25-74)															
1971		-33.59	-1.78		25.40	0.97		-19.86	-1.39		0.66	0.04		-1.38	-2.76
1986		-18.01	-1.74		16.83	1.06		-17.74	-2.57		-12.82	-1.54		-0.24	-0.66
1991		-28.80	-2.88		6.56	0.40		-32.19	-4.91		-27.95	-3.29		-0.05	-0.13
1996		-52.49	-5.10		-37.55	-2.53		-21.20	-3.00		-31.22	-3.79		-2.88	-8.54
Diabetes mellitus (0-49)	‡			‡			‡			‡			11		
1971														0.56	1.12
1986														0.23	0.64
1991														0.24	0.67
1996														0.03	0.09
Hypertensive disease (35-74)	‡			‡			‡			‡					
1971														0.95	1.91
1986														0.49	1.37
1991														-0.05	-0.15
1996														-0.02	-0.05

Abbreviations: SEYLL: age-standardized period expected years of life lost,
EYLL: period expected years of life lost, SPYLL: age-standardized potential years of life lost,
PYLL: potential years of life lost, ASMR: age-standardized mortality rate, RD: rate difference
*95% confidence interval does not include a zero value
†Ranked according to percent of all cause QT-Q1 (mortality indicator) RD in 1996
§Percent of all cause QT-Q1 (mortality indicator) RD
‡This cause did not contribute at least 1%

Cause-specific contribution to QT-Q1 and Q5-Q1 SEYLL rate difference

Table 3.11 presents the cause-specific contribution to all cause QT-Q1 and Q5-Q1 SEYLL RD for males and females from 1971 to 1996. These causes were ranked according to their contribution to mortality differences in 1996. For males, comparing QT-Q1 or Q5-Q1 did not change the cause of death rank order considerably. In contrast, for females, the ranking for some causes were different between QT-Q1 and Q5-Q1 comparisons. The causes whose rankings were influenced by whether QT-Q1 or Q5-Q1 was examined did not contribute substantially to all cause SEYLL difference (less than 2%). On the other hand, the rankings for the causes with substantial SEYLL disparities (greater than 2%) were comparable between QT-Q1 and Q5-Q1 comparisons. In 1996, ischaemic heart disease, lung cancer, perinatal mortality, cirrhosis of the liver (for males only), and cerebrovascular disease made the greatest contribution to all cause absolute QT-Q1 and Q5-Q1 SEYLL disparity.

Table 3.11: QT-Q1and Q5-Q1 'Avoidable' SEYLL rate difference per 100,000 population, by cause of death (age range in parentheses), by sex, urban Canada, 1971 to 1996

		Males						Females					
		QT-Q1			Q5-Q1			QT-Q1			Q5-Q1		
Rank	Year	Cause	RD	%	Cause	RD	%	Cause	RD	%	Cause	RD	%
1		Ischaemic heart disease (35-74)			Ischaemic heart disease (35-74)			Ischaemic heart disease (35-74)			Ischaemic heart disease (35-74)		
	1971		724.32*	18.21		1800.19*	19.48		291.77	15.45		694.58*	16.15
	1986		601.79*	19.93		1241.25*	16.11		197.57*	19.03		442.20*	15.45
	1991		414.22*	15.41		939.07*	12.87		175.67*	17.59		425.87*	15.33
	1996		337.03*	14.14		762.31*	11.95		164.22*	15.95		430.23*	16.06
2		Lung cancer (0-74)			Lung cancer (0-74)			Lung cancer (0-74)			Lung cancer (0-74)		
	1971		226.85	5.70		533.18*	5.77		30.40	1.61		55.28	1.29
	1986		341.89*	11.32		762.30*	9.89		104.45	10.06		221.23*	7.73
	1991		253.14*	9.42		663.04*	9.09		86.99	8.71		190.59*	6.86
	1996		207.46*	8.70		504.52*	7.91		112.49*	10.92		205.63*	7.67
3		Perinatal conditions			Perinatal conditions			Perinatal conditions			Perinatal conditions		
	1971		383.99*	9.66		667.72*	7.23		219.49	11.62		540.06*	12.55
	1986		107.45	3.56		252.60*	3.28		75.03	7.23		185.88*	6.50
	1991		47.44	1.77		140.50*	1.93		29.76	2.98		142.99*	5.15
	1996		136.42	5.72		250.68*	3.93		65.09	6.32		125.39*	4.68
4		Cirrhosis of the liver (0-74)			Cirrhosis of the liver (0-74)			Cerebrovascular disease (35-74)			Cerebrovascular disease (35-74)		
	1971		208.62*	5.25		572.37*	6.20		37.32	1.98		110.56	2.57
	1986		100.71*	3.34		315.45*	4.09		56.03	5.40		124.77*	4.36
	1991		110.55*	4.11		332.90*	4.56		25.93	2.60		109.72*	3.95
	1996		88.53*	3.71		239.66*	3.76		43.76	4.25		96.23*	3.59
5		Cerebrovascular disease (35-74)			Cerebrovascular disease (35-74)			Cervical cancer (15-74)			Pneumonia (0-74)		
	1971		75.10	1.89		212.64*	2.30		87.42	4.63		209.72*	4.88
	1986		114.33*	3.79		292.02*	3.79		37.43	3.61		115.57*	4.04
	1991		79.94*	2.97		215.81*	2.96		17.10	1.71		53.50*	1.93
	1996		86.85*	3.64		205.36*	3.22		14.90	1.45		33.91	1.27
6		Congenital cardiovascular anomalies (0-74)			Pneumonia (0-74)			Cirrhosis of the liver (0-74)			Cervical cancer (15-74)		
	1971		81.77	2.06		411.55*	4.45		75.72	4.01		191.81*	4.46
	1986		47.01	1.56		175.56*	2.28		36.78	3.54		84.32*	2.95
	1991		21.06	0.78		147.31*	2.02		43.69	4.38		69.78*	2.51
	1996		30.57	1.28		119.01*	1.87		12.12	1.18		33.47*	1.25
7		Pneumonia (0-74)			Congenital cardiovascular anomalies (0-74)			Motor vehicle accidents (0-74)			Cirrhosis of the liver (0-74)		
	1971		157.68	3.97		134.39*	1.45		60.53	3.21		236.09*	5.49
	1986		69.94*	2.32		91.81*	1.19		-72.66	-7.00		92.90*	3.25
	1991		60.00*	2.23		32.77	0.45		-21.17	-2.12		134.59*	4.84
	1996		29.33	1.23		74.19*	1.16		10.64	1.03		22.03	0.82
8		Emphysema (0-74)			Emphysema (0-74)			Uterine cancer (15-74)			Chronic rheumatic heart disease (0-74)		
	1971		61.26	1.54		130.83*	1.42		40.41	2.14		92.05*	2.14
	1986		26.91	0.89		60.25*	0.78		8.35	0.80		4.93	0.17
	1991		20.94	0.78		51.05*	0.70		11.17	1.12		19.79*	0.71
	1996		7.78	0.33		19.51*	0.31		10.28	1.00		17.45	0.65
9		Motor vehicle accidents ((0-74)			Motor vehicle accidents ((0-74)			Chronic rheumatic heart disease (0-74)			Uterine cancer (15-74)		
	1971		214.69	5.40		167.86	1.82		34.45	1.82		71.72*	1.67
	1986		-26.64	-0.88		-66.97	-0.87		8.61	0.83		21.49	0.75
	1991		-59.52	-2.22		-70.37	-0.96		12.89	1.29		17.26	0.62
	1996		-101.71	-4.27		-223.19*	-3.50		8.17	0.79		15.76	0.59
10		‡			‡			Pneumonia (0-74)			Motor vehicle accidents (0-74)		
	1971								99.48	5.27		-21.95	-0.51
	1986								38.09	3.67		-53.60	-1.87
	1991								18.82	1.89		-28.83	-1.04
	1996								7.98	0.78		2.86	0.11
11		‡			‡			Congenital cardiovascular anomalies (0-74)			Breast Cancer (25-75)		
	1971								13.22	0.70		-41.14	-0.956
	1986								14.71	1.42		-25.46	-0.89
	1991								28.00	2.80		-3.81	-0.137
	1996								-11.96	-1.16		-42.71	-1.594
12		‡			‡			Breast Cancer (25-75)			‡		
	1971								-33.59	-1.78			
	1986								-18.01	-1.74			
	1991								-28.80	-2.88			
	1996								-52.49	-5.10			

Abbreviations: Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, RD: rate difference

*95% confidence interval does not include a zero value

†Ranked according to percent of all cause QT-Q1 SEYLL RD in 1996

§Percent of all cause Q5-Q1 or QT-Q1 SEYLL RD

‡No other causes contributed at least 1%

3.7 Sentinel Health Events: Unnecessary Untimely Deaths

Table 3.12 presents the "unnecessary untimely deaths", by neighbourhood income quintile, for the causes of death that did not contribute greater than 1% to QT-Q1 SEYLL RD in 1996. These "Sentinel Health Events", as proposed by Rutstein et al., warrant the question "Why did this happen?" There were very few deaths for many of the condition mentioned in this table (there were less than 5 deaths in 1996 for 10 out of the 20 conditions mentioned in Table 3.12). For most of the conditions with greater than 5 deaths in 1996 (including deaths from skin cancer, diseases of the thyroid, influenza, bronchitis, asthma, appendicitis, abdominal hernia and maternal mortality), there were no apparent mortality disparities between the quintiles. However, a disproportionate number of deaths from tuberculosis and emphysema were occurred among the poorest quintiles. For example, the pooreste quintile experienced 8 times more deaths from Tuberculosis compared to the richest quintile. Males in the poorest quintile experienced almost twice the number deaths from emphysema as males in the richest quintile.

Table 3.12: Unnecessary untimely deaths, by neighbourhood income quintile, by cause of death (age range in parentheses), by sex, urban Canada, 1971 to 1996*

	Males						Females					
YEAR	QT	Q1	Q2	Q3	Q4	Q5	QT	Q1	Q2	Q3	Q4	Q5
Intestinal infections (0-14)												
1971	12	1	2	4	3	2	12	1	1	3	3	4
1986	1	0	0	1	0	0	3	0	0	0	2	1
1991	0	0	0	0	0	0	0	0	0	0	0	0
1996	1	0	0	1	0	0	3	0	0	0	3	0
Tuberculosis (0-74)												
1971	108	9	6	14	25	54	54	7	6	8	11	21
1986	37	2	2	8	11	14	13	2	2	0	2	7
1991	31	0	0	4	6	21	25	0	7	5	7	6
1996	21	1	3	2	4	11	16	1	5	3	2	5
Diptheria (0-74)												
1971	1	0	0	0	0	0	2	0	0	0	0	2
1986	0	0	0	0	0	0	0	0	0	0	0	0
1991	1	0	0	0	0	1	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0
Whooping cough (0-14)												
1971	0	0	0	0	0	0	1	0	0	0	1	0
1986	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0
1996	1	0	1	0	0	0	1	1	0	0	0	0
Tetanus (0-74)												
1971	0	0	0	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0
Poliomyelitis (0-74)												
1971	3	0	2	1	0	0	5	1	0	1	1	2
1986	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0
Measles (1-14)												
1971	3	2	0	1	0	0	3	2	0	1	0	0
1986	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0	0	0
Syphylis (0-74)												
1971	4	0	0	0	0	4	3	1	0	0	0	2
1986	0	0	0	0	0	0	1	0	0	1	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	1	0	1	0	0	0
Skin cancer (0-74)												
1971	21	1	4	6	6	3	15	2	0	2	6	5
1986	17	3	1	1	6	6	7	2	1	0	3	1
1991	28	2	3	5	8	10	10	0	1	2	3	4
1996	36	7	10	7	8	4	13	3	3	3	2	2

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile
*As described by Rutstein et al.[76,102]

Table 3.12: Unnecessary untimely deaths, by neighbourhood income quintile, by cause of death (age range in parentheses), by sex, urban Canada, 1971 to 1996 (continued)*

	Males						Females					
YEAR	QT	Q1	Q2	Q3	Q4	Q5	QT	Q1	Q2	Q3	Q4	Q5
Diseases of the thyroid (0-74)												
1971	8	1	1	3	1	2	21	3	3	2	4	9
1986	5	2	0	1	1	1	8	0	3	0	3	2
1991	1	0	0	1	0	0	7	0	1	3	1	2
1996	4	0	1	0	2	1	8	0	0	1	1	5
Deficiency anaemia (0-74)												
1971	4	0	0	0	1	3	5	0	1	2	1	1
1986	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	2	1	0	0	0	1
Active rheumatic fever (0-74)												
1971	3	0	1	2	0	0	4	0	1	2	0	1
1986	0	0	0	0	0	0	0	0	0	0	0	0
1991	1	0	0	0	0	1	2	1	0	0	0	1
1996	0	0	0	0	0	0	1	0	0	0	0	0
Acute respiratory infections [except influenza] (1-14)												
1971	6	2	1	3	0	0	7	1	0	3	3	0
1986	0	0	0	0	0	0	1	0	0	1	0	0
1991	3	1	1	1	0	0	3	0	2	0	0	1
1996	1	0	0	0	0	1	2	1	1	0	0	0
Influenza (0-74)												
1971	31	5	7	5	7	7	31	1	2	9	6	12
1986	5	2	0	0	2	1	12	0	3	4	3	2
1991	5	0	1	3	0	1	5	1	0	0	0	4
1996	2	1	0	0	0	1	4	1	3	0	0	0
Bronchitis (0-74)												
1971	9	3	0	3	0	3	11	3	0	2	0	6
1986	9	0	2	0	2	5	5	1	0	2	1	1
1991	11	0	0	3	3	5	8	1	2	1	1	3
1996	3	1	0	0	0	2	6	0	0	4	1	1
Emphysema (0-74)												
1971	373	34	43	73	88	134	64	6	14	11	13	20
1986	207	18	26	44	47	71	110	13	15	18	34	28
1991	207	20	26	39	52	70	99	12	9	24	32	22
1996	153	22	25	31	36	37	109	17	17	26	28	20
Asthma (0-49)												
1971	11	4	2	1	1	3	14	2	2	1	3	6
1986	37	2	11	7	7	9	20	4	8	2	4	2
1991	25	0	8	4	4	9	28	4	6	6	6	6
1996	20	6	0	4	4	5	19	3	4	4	4	4
Appendicitis (0-74)												
1971	17	1	7	2	3	4	14	3	0	5	4	2
1986	10	2	0	2	2	4	5	1	2	0	1	1
1991	7	1	0	1	3	2	4	0	0	3	0	1
1996	4	1	1	1	1	0	6	0	2	1	2	1
Abdominal hernia (0-74)												
1971	44	5	6	6	8	19	24	1	7	3	6	6
1986	11	0	0	1	5	5	9	3	2	2	0	2
1991	15	2	3	4	3	3	6	2	1	1	1	1
1996	19	4	3	2	4	6	11	1	2	2	4	2
Maternal mortality (0-74)												
1971							19	3	1	3	4	8
1986							8	3	1	0	0	4
1991							6	2	0	0	4	0
1996							10	2	3	1	1	3

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile
*As described by Rutstein et al.[76,102]

Chapter 4 Interpretation of Results

4.1 'Avoidable' Mortality Disparity Trends

Quintile avoidable SEYLL differences in urban Canada decreased substantially for both sexes from 1971 to 1996, irrespective of which classification list was considered. For males, avoidable SEYLL differences diminished principally from 1971 to 1991. From 1991 to 1996, avoidable SEYLL disparities diminished to a lesser extent and even increased according to some classification lists. For females, avoidable SEYLL inequalities decreased mainly from 1971 to 1986 and from 1991 to 1996. From 1986 to 1991, avoidable SEYLL disparities were smaller and even increased according to some classificationlists.

Two previous studies examined temporal trends in socioeconomic avoidable mortality (AM) disparity. Both of these studies focussed on deaths amenable to medical intervention. In New Zealand, Marshall et al.[95] found that the strength of the social class gradient diminished for medically amenable deaths from 34% 1975-1977 to 28% in1985-1987. Mackenbach et al.[9] observed that the decline in mortality from medically amenable causes of death during the period 1959-1963 to 1982-1983 was greater in higher occupational classes. The Mackenbach 1988 and Charlton 1983 classification lists considered in this study are comparable to the lists applied in the Mackenbach et al. and Marshall et al. studies, respectively. Referring to the Mackenbach 1988 and Charlton 1983 lists, we observed that disparities in mortality amenable to medical intervention diminished considerably from 1971 to 1991. This suggests that the mortality disparity time-trends for death amenable to medical intervention vary between countries: while medically amenable mortality inequalities diminished in Australia between 1975 and 1987 and urban Canada from 1971 to 1991, inequalities widened in England and Wales from 1959 to 1983. On the other hand, from 1991 to 1996, although avoidable SEYLL inequalities in Canada decreased in females, they in fact increased in males when considering both the Charlton 1983 and Mackenbach 1988 lists. This recent trend in males can be attributed to the incrase mortality disparities related to deaths from perinatal conditions from 1991 to 1996 (Table 3.8 and Figure 3.5).

Considering avoidable deaths as classified by the master list, the absolute disparities in mortality amenable to medical intervention diminished substantially in urban Canadian men and women from 1971 to 1991. Over the same time period, quintile differences in mortality not considered avoidable decreased marginally in women and increased in men. This suggests that medical care has contributed considerably to reducing mortality disparities in urban Canada over the 20-year period. From 1991 to 1996, disparities in mortality amenable to medical care continued to decrease in women but showed little change in men.

Absolute disparities in mortality amenable to public health diminished consistently for men, but did not change in women from 1971 to 1996. From 1971 to 1986, female mortality amenable to pulbic health changed very little due to increased lung cancer mortality inequality balanced my decreased cirrhosis of the liver inequality. From from 1986 to 1991, public health amenable mortality disparity increased in women, due to augmented cirrhosis of the liver mortality differences between the richest and poorest quintiles. From 1991 to 1996, mortality inequality related to deaths amenable to public health decreased in women, mainly because of a noticeable recdution in cirrhosis of the liver mortality in the poorest quintile.

It must be noted that interpreting aggregated AM trends should be done with caution. The reason for this is that grouping causes of death into broad categories risks being misleading.

Individual causes may have different temporal trends compared to what is observed when they were aggregated. For example, the three causes considered in this study as amenable to public health (lung cancer, cirrhosis of the liver, and MVAs) had different mortality disparity trends. From 1971 to 1996, mortality disparity related to deaths from lung cancer did not change considerably, whild disparitied related to cirrhosis of the liver decreased from 1971 to 1986 and from 1991 to 1996. MVA mortality has been greater in richer quintiles since 1986. When aggregated, the results show that mortality disparity amenable to public health decreased consistently in males from 1971 to 1996. Furthermore, different health care services are responsible for the various causes of death. For example, MVA deaths are considered amenable to legal measures (such as speed limits and seat belt laws), whereas lung cancer deaths are regarded as amenable to smoking cessation and prevention programs. Finally, the validity of AM as an indicator of health care effectiveness has not been proven.

4.2 Causes that Contributed Greater than 1% to Absolute Mortality Disparity in 1996

Ten 'avoidable' causes of death contributed at least 1% to all cause mortality disparity in 1996. This section discusses trends for only those causes that contributed greater than 1% to absolute all cause mortality disparity in 1996. For many of these causes (specifically, ischaemic heart disease, lung cancer, perinatal mortality, cirrhosis of the liver, female breast cancer, and motor vehicle accidents) the age-standardized mortality trends were described by Wilkins et al.[31] This study expands on their work by (a) considering specific age ranges for which deaths from these causes could be considered avoidable, (b) presenting these trends in terms of avoidable years of life lost, and (c) determining relative contribution of these causes to mortality disparity in urban Canada in 1996.

4.3.1 Ischaemic Heart Disease (ages 35-74 years)

Ischaemic heart disease (IHD) was the greatest contributor to all cause years of life lost disparity in the years considered, contributing increasingly from 1971 to 1996. Mortality disparity from IHD decreased consistently in males from 1971 to 1996. However, IHD mortality disparity did not change remarkably in females from 1986 to 1996 and there remained very large differences between the rich and poor quintiles for both sexes in 1996. These observations support work done in Winnipeg, Manitoba by Roos and Mustard[39] who demonstrated that persons living in the poorest enumeration areas had a 43% greater risk of age- and sex- standardized mortality from ischaemic heart disease compared to those living in the richest areas.

Analyzing data from the Saskatchewan Heart Health Survey given to adults aged 18 to 74 years in 1990, Reeder et al.[161] found that individual education was significantly associated ($p<0.05$) with age-standardized prevalence of angina in men and women. Also, in a recent study linking the Ontario Myocardial Infarction Database to provincial hospital-discharge abstracts and physician service claims, Alter et al.[55,56] observed that patients who lived in lower-income neighbourhoods were (a) less likely to undergo catheterization ($p<0.001$) and (b) had longer waiting times for coronary angiography ($p<0.001$). After adjusting for age, sex, illness severity, specialty of the attending physician, and hospital characteristics, Alter et al. observed that a $10,000 increase in neighbourhood median income was associated with a 10% reduction in the risk of death within one year of invasive cardiac procedures ($p<0.001$).

Taken together, the observations noted above suggest that there still remain differences in health services that contribute to disparities in ischaemic heart disease mortality. That being said, efforts to reduce these disparities will need to consider other factors in addition to access to medical care services.

4.3.2 Lung Cancer (ages 0-74 years)

For both males and females, lung cancer was the second greatest contributor to years of life lost disparity in urban Canada. Interestingly, due to differences in mortality and mortality disparity trends between males and females, the contribution of lung cancer generally decreased for males, yet remained elevated (at around 10%) for females. In addition, lung cancer absolute mortality disparity in males increased from 1971 to 1986 and decreased from 1986 to 1996, resulting in a small net change in absolute disparity between 1971 and 1996. For females, lung cancer mortality and mortality disparity consistently increased from 1971 to 1996. This trend is disturbing and warrants further study.

Stavraky et al.[36] did not find a significant association between education and lung cancer survival for men and women admitted to regional cancer centres in Ontario during 1980-1982 (hazard ratio 1.30, 95%CI 0.93-1.80 for persons with greater than 12 years of education compared to persons with 12 years or less of education). In another study, Gorey et al.[49] also did not find a link in the Greater Toronto Area between census tract-level socioeconomic status and 1- or 5-year survival with lung cancer in males (1-year survival rate ratio [1ySRR] 1.04, 95%CI 0.94-1.15; 5ySRR 0.82, 95%CI 0.61-1.10) or females (1ySRR 0.96, 95%CI 0.88-1.05; 5ySRR 1.19, 95%CI 0.91-1.55) diagnosed between 1986 and 1992.

However, Gorey et al.[44] did find a significant association between census tract socioeconomic status and lung cancer incidence among residents of Toronto 25 years of age and older between

1986 and 1993 (rate ratio [RR] 1.26, 95%CI 1.18-1.34 for women and RR 2.59, 95%CI 2.27-2.96 for men of low income compared to women and men of high income). The risk of lung cancer incidence among low-income individuals was twice as high in females as compared to males. Recently, using data collected from mailed questionnaires returned from 3,280 newly diagnosed lung cancer cases and 5,073 population controls between 1994 and 1997 in Canada, Mao et al.[162] showed that household income and education were significantly related to risk of lung cancer in males (adjusted odds ratio [aOR] 1.7, 95% confidence interval [95%CI] 1.3-2.2) and females (aOR 1.5, 95%CI 1.1-2.0), independently of pack-years of smoking, cumulative years of exposure to environmental tobacco smoke, and total consumption of vegetables and meat.

In all, the studies cited in this section suggest that socioeconomic differences in lung cancer mortality in Canada are attributable to differences in lung cancer incidence rather that survival with this cause. Therefore, public health initiatives will have a central role in reducing mortality disparities from lung cancer.

4.3.3 Perinatal Conditions

Absolute mortality disparity from perinatal conditions decreased substantially from 1971 to 1991. In males, due to a recent increase in perinatal deaths in the poorer quintiles, quintile mortality differences increased from 1991 to 1996. Perinatal mortality was the third greatest contributor to years of life lost disparity for both sexes in 1996. The widening of socioeconomic mortality differences related to perinatal conditions is troubling and warrants further study.

Low birth weight (LBW) and premature births are associated with approximately 75% of all perinatal deaths.[163] Disparities in LBW have been demonstrated in Manitoba,[164,165] Ontario,[163,166] and Alberta.[167] The percentage of LBW births in Canada increased from 5.5 in 1985 to 5.8 in 1997. [168,169] Furthermore, Wilkins and Houle[169] showed that the differences in the rate of live births of LBW babies between the richest and poorest neighbourhood income quintile increased in urban Canada from 1.9% in 1991 to 2.1% in1996.

In a meta-analysis conducted by Kramer,[170] maternal smoking was found to be the single most important modifiable risk factor for LBW. In another study, Wilkins et al.[169,171] suggested that increases in smoking prevalence accounted for half to two-thirds of the observed increase in LBW rates among teenage mothers during the 1991 to 1996 time period. Moreover, Mustard and Roos[164] observed that the disparities in LBW between infants born to women from the low versus high income quintiles in Winnipeg were primarily attributable to differences in income status, treaty status (non-Native or Native), parity, smoking status and pregnancy complications, but only a small proportion could be explained by differences in the utilization of prenatal care. In a recent review of the causal pathways and mechanisms of socioeconomic disparities in preterm birth, Kramer et al.[172,173] concluded that the leading factors mediating the association between low socioeconomic status and unfavourable birth outcomes include chronic stressors, psychosocial stress and health behaviours (especially smoking and nutrition).

In sum, the above-noted studies suggest that although mortality and mortality disparity from perinatal conditions have decreased dramatically over the past decades, there exists considerable room for improvement. It is also important to note that mortality inequalities related to perinatal conditions have recently increased.[31,171] Although the pathways through which socioeconomic differences influence perinatal mortality are not totally understood at this time, recent studies suggests that public health will need to play an important role in reducing these disparities.

4.3.4 Cerebrovascular Disease (ages 35-74 years)

Cerebrovascular disease (stroke) contributed notably to absolute years of life lost disparity among both men and women. For both sexes, the poorest quintile experience markedly greater mortality compared to the richer quintiles in all of the years considered. Mortality disparity was greater in men, increasing from 1971 to 1986 and generally decreasing afterwards. This observation follows previous work done by Wilkins,[174] that demonstrated increasing stroke mortality disparities in men from 1971 to 1986, especially for those aged 25 to 64 years. The findings presented here suggest that stroke mortality disparity decreased from 1986 to 1991, but did not change considerably from 1991 to 1996. The gap between the richest and poorest quintiles remained significant for men and women in 1996.

An inquiry into cerebrovascular disease mortality disparity in Ontario was recently conducted by Kapral et al.[57] Linking hospital discharge abstracts and vital-status data for all patients with acute stroke admitted to hospital in Ontario between 1994 and 1997, Kapral et al. found that patients from poorer income areas were (a) less likely to have access to hospitals with neurologists and neurology technologies ($p<0.001$), (b) less likely to receive rehabilitation services during admission ($p<0.001$), and (c) had longer waiting times for carotid endarterectomy after stroke ($p=0.002$). However, after adjusting for age, sex, comorbidity, and physician and hospital characteristics, Kapral et al. calculated that for each $10,000 increase in median area income, there was a 9% reduction in 30-day mortality ($p<0.001$), and a 5% reduction in 1-year mortality (p=0.009). These finding imply that although access to health care is an issue, other factors are influencing the socioeconomic mortality disparities observed.

4.3.5 Cirrhosis of the Liver (ages 0-74 years)

Between 1971 and 1996, the proportion of all cause mortality disparity attributable to deaths from cirrhosis of the liver was comparable between males and females. As well, temporal trends from 1971 to 1991 indicate that important reductions in mortality disparity occurred for both sexes. In 1996, however, while female quintile mortality differences were not significant (Q5-Q1 rate ratio [Q5-Q1 RR] 1.35, 95%CI 0.90-2.03), males continued to experience substantial quintile disparities (Q5-Q1 RR 3.17, 95%CI 2.48-4.06). Similar results were observed in Sweden by Westerling et al.,[92] whose study, conducted between 1986 and 1990, concluded that age and sex-standardized mortality from liver cirrhosis was significantly ($p<0.001$) greater among individuals aged 21 to 64 years who were not working compared to those with an occupation.

In the United States a recent comprehensive study by Singh and Hoyert[175] found that, after adjusting for ethnicity, marital status, nativity and education, family income and occupation were significantly associated with liver cirrhosis mortality in men and women (hazard ratio 2.17, 95%CI 1.20-3.93 for persons in the lowest family income groups compared to persons in the highest family income group). Singh and Hoyert also showed that alcohol consumption and liver cirrhosis mortality time-trends correspond closely with each other and appeared to behave in a similar fashion. This was particularly the case for hard liquor consumption.

In an ecological study of Canadian provinces, Xie et al.[176] showed that there existed a link between Alcoholics Anonymous (AA) memberships and per capital alcohol consumption with cirrhosis mortality ($p<0.05$). Xie et al. also found that drinking age regulations and the number of licensed premises in a given community were indirectly associated with cirrhosis mortality through their relationship with alcohol consumption. Analyzing data from the 1990 Ontario Health Survey, Pomerleau et al.[177] found that persons with lower education ($p<0.001$) and income ($p<0.01$) were more likely to consume more than 14 alcoholic drinks per week. Examing data from the 1993 Canadian General Social Survey, Single et al.[178,179] showed that persons with low income adequacy and less than secondary education were more likely to report (a) drinking 5 or more drinks on an occasion and (b) having a problem with their drinking. Investigating data from the 1994 Canadian Alcohol and Other Drugs Survey, Poulin et al.[180] demonstrated that having a low income adequacy ($p<0.01$) and less than secondary education ($p<0.001$) was significantly associated with having an alcohol disorder.

4.3.6 Motor Vehicle Accidents (ages 0-74 years)

Since 1971, greater mortality from motor vehicle accidents (MVAs) has been observed in richer quintiles compared to poorer quintiles. Although these differences were less pronounced in females, this trend continued for males from 1986 to 1996. It is interesting to note that the MVA mortality trends observed by Wilkins et al.,[31] which were presented in terms of age-standardized mortality rates, are dissimilar when compared to the years of life lost trends shown in this study. This discrepancy can be partly explained using results from a study by Wilkins et al.,[171,181] that demonstrated that childhood (ages 1 to 14 years) deaths from MVAs decreased from 76 per million in 1971, to 9 per million in 1996. Together, these results suggest that mortality disparities from MVAs in 1971 were influenced by premature deaths in children, whereas the quintile differences observed in 1996 were mainly due to death experiences of adults. However age group specific trends would need to be conducted to confirm this interpretation.

The trends observed in urban Canada are in contrast with the United States findings.[182,183] For example, analyzing data from 261,723 death certificates in the United States from 1984 to 1997, Steenland et al.[182] recently demonstrated a strong inverse association between motor vehicle mortality and occupation- and education-based socioeconomic status (RR 2.73, 95%CI 2.62-2.85 for men and RR 1.55, 95%CI 1.47-1.64 for women from the highest socioeconomic group compared to men and women from the lowest socioeconomic group).

Reductions in mortality from MVAs have been attributed to improvements in both regulatory policy and educational and product-safety improvement in Canada over time.[171] It has been suggested that persons with higher incomes may experience greater MVA mortality risk due to their increased exposure to motor vehicle travel. For this reason, estimating death rates per unit of travel may be the more appropriate means of comparing risks between population groups.[183]

4.3.7 Female Breast Cancer (ages 25-74 years)

In all of the years considered, female breast cancer mortality rates were generally higher in the richer quintiles than the poorer quintiles, contributing increasingly against all cause mortality disparity from 1971 to 1996. However, the difference in breast cancer mortality was not significant from 1971 to 1996 (Q5-Q1 RR 0.93, 95%CI 0.81-1.08 in 1996).

There has been considerable debate in the literature regarding the relationship between breast cancer and socioeconomic status in Canada. When examining cancer cases from the Ontario

Cancer Registry, Boyd et al.[184] and Mackillop et al.,[37] showed significant ($p<0.05$) differences in 5-year survival rates between the richest and poorest residential areas (enumeration area and subdivision for urban and rural areas, respectively). In contrast, Stavraky et al.[36] found weak and inconsistent associations between breast cancer survival and education- and occupation-based socioeconomic status for women aged 25 to 70 who were admitted to regional cancer centres in Ontario during 1980-1982. In other studies, Gorey et al.[45,49] also did not find a link between neighbourhood (defined by census tract) socioeconomic status and 1- or 5-year survival rate for the 10,000 diagnosed cases of breast cancer between 1986 and 1992 in the Greater Metropolitan Toronto and Winnipeg areas. In addition, Gorey et al.[44,185] suggested that the socioeconomic mortality trends observed by Boyd et al. and Mackillop et al. were influenced by the large area units they included when considering rural areas, a factor which may have been more indicative of rural regional differences in breast cancer mortality than individual socioeconomic differences.

Gorey et al.[44,185] showed that breast cancer incidence in metropolitan Toronto was 11% lower in low-income compared to high-income census tracts, however the difference was not significant at the $p=0.05$ level. When comparing questionnaire responses between 2,531 women newly diagnosed with breast cancer aged 25 to 74 and 2,438 female population controls in Canada, Johnson et al.[186] found that higher premenopausal risk of having breast cancer was associated with higher education ($p=0.18$ for the test for trend across education groups) and family income adequacy ($p=0.14$).

In sum, the above-cited studies suggest that although breast cancer deaths in Canada are somewhat higher in richer socioeconomic groups, the disparities in breast cancer mortality, survival and incidence are not significant. Although it has been argued that the incidence differences are due to behavioural and environmental factors, such as diet, sedentary lifestyle, and sunlight exposure (which are associated with leisure pursuits), research supporting such a hypothesis is currently not available.[44,185,187] Furthermore, the observed elevated breast cancer incidence in Canadian women of higher socioeconomic status may have been due to detection bias, in that these women are more likely to seek breast cancer screening than women of lower socioeconomic status.[50]

4.3.8 Congenital Cardiovascular Anomalies (ages 0-74 years)

Even though there was evident mortality disparity among males and females from congenital cardiovascular anomalies between 1971 and 1986, mortality from congenital cardiovascular anomalies generally decreased for the poorer quintiles from 1971 to 1996. It is important to note, however, that males in the poorest quintile experienced increasing mortality from this cause from 1991 to 1996, leading to a significant difference between males in the richest and poorest quintiles in 1996 (Q5-Q1 RR 2.01, 95%CI 1.11-3.64).

The association between socioeconomic status and congenital anomalies has not yet been the subject of a comprehensive study in Canada. In an exploratory case-control study using data from the British Columbia Health Surveillance Registry for the 1952 to 1973 time period, Olshan et al.[188,189] found that paternal occupation was associated with ventricular septal defects (odds ratio [OR] 2.45 for the lowest occupational class compared to the highest occupational class). Also, recent work conducted in Canada by Wen et al.[190,191] demonstrated that although deaths from congenital anomalies have decreased significantly over the past decades, there nevertheless remain major regional variations in Canada.

4.3.9 Cervical Cancer (ages 15-74 years)

Although cancer of the cervix uteri contributed considerably to all cause years of life lost disparity from 1971 to 1986, its contribution during the 1986 and 1996 time period was less apparent. Overall, mortality disparity from cancer of the cervix uteri decreased substantially from 1971 to 1996. This was a result of decreases in mortality for the poorest quintiles. However, mortality disparity from cancer of cervix uteri remained significant in 1996 (Q5-Q1 RR 1.72, 95%CI 1.03-2.85).

Cervical cancer survival has not been shown to be related to socioeconomic status.[36,49] For example, Gorey et al.[49] observed that 1- and 5-year survival of patients 25 years of age and older with cancer of the cervix uterus was not associated with census tract income levels in Toronto for the period 1986-1988 (1ySRR 1.01, 95%CI 0.95-1.07; 5ySRR 1.03, 95%CI 0.77-1.38 for women from the lowest income group compared to women from the highest income group). However, later work by Gorey et al.[44] did demonstrate that cervical cancer incidence was significantly greater in low- versus high-income residents of Toronto during the period 1986-1993 (age-adjusted incidence rate ratio 1.53, 95%CI 1.29-1.82). What is important to note is that Papanicolaou (PAP) screening has been shown to be less common among women with lower education and family income in Ontario[52,192] and more recently in Canada.[193]

When taken together, the results cited in this section suggest that although cervical cancer mortality disparities have been greatly reduced, important inequalities remain and these inequalities may be more related to cervical cancer incidence rather than survival with this condition.

4.3.10 Pneumonia (ages 0-74 years)

The contribution of pneumonia to absolute years of life lost disparity was considerable in 1971, but strongly decreased from 1971 to 1996. For both males and females, mortality disparity from pneumonia decreased from 1971 to 1991, as a result of substantial reductions in mortality in the poorest quintiles. From 1991 to 1996, mortality disparity from pneumonia continued to decrease for females, but remained significant for males (Q5-Q1 RR 2.43, 95%CI 1.67-3.53).

Significant occupation-based social group differences in mortality from pnuemonia have been observed for British Columbian men aged 15 to 65 during the 1981 to 1991 time period (RR 2.3, 95%CI 1.4-4.0 for men in the lowest social group compared to men in the highest social group).[35] The mechanisms of how socioeconomic status may influence mortality caused by pneumonia have not yet been investigated in Canada. Recently, Malcolm and Marrie[194] showed that the use of antibiotic therapy for patients with community-acquired pneumonia, treated in an emergency department settings in Edmonton, varied according to patients characteristics and hospital site. However, socioeconomic factors were not considered in the Malcolm and Marrie study. In France, Stelianides et al.[195] demonstrated that low socioeconomic status was not related to the severity presentation or the outcome of community-acquired pneumonia. However this study did observe a longer length of hospitalization for patients classified as of low socioeconomic status compared to all other patients (5.9 days longer, 95%CI 2.2-9.5). In another study, Loeb,[196] stressed the need to understand how factors and underlying biological mechanisms influence the relationship between socioeconomic status and community-acquired pneumonia in Canada.

Overall, the results of this study suggest that recent disparities in pneumonia differ between males and females and perhaps future research should be aimed at confirming this observation and determining why it exists.

4.3 Causes that Contributed 1% or Less to Absolute Mortality Disparity in 1996

Many of the avoidable causes of death considered in this study did not contribute greater than 1% to absolute all cause QT-Q1 SEYLL RD in 1996. For these causes, we did not find significant quintile disparities as measured using rate difference or rate ratios. The total number of deaths for some of these causes was quite low, indicating a generally high quality of care in Canada for these causes. Nevertheless, a single death from certain causes could be considered a sentinel event that deserves further inquiry. Also, for some causes, it must be noted that the trends observed may not be indicative of the mortality inequalities related to these conditions.

4.2.1 Sentinel Health Events: Unnecessary Untimely Deaths

Although the causes outlined below did not contribute significantly to mortality disparity, when considered in the context of the "sentinel health events" concept, a single death from the following causes warrants the question "Why did this happen?"

Infectious diseases

For most of the infectious diseases considered in this study, there were no noticeable disparities in mortality. One exception was tuberculosis: in 1996, the poorest quintile experienced 11 avoidable deaths from tuberculosis, while the richest quintile only experienced 1. Tuberculosis incidence has previously been shown to be linked to low-income urban areas in Canada.[197,198] These observations are partly attributable to the fact that immigrants from countries where tuberculosis prevalence is high tend to reside in poorer urban areas.[198-200] In addition, poorer urban areas have also been shown to have higher rates of transmission and infectiousness, which may be due to the poorer sanitary conditions of these districts as well as to behavioural and community risk factors.[31,199,200] Since tuberculosis is both a preventable and curable condition, there remains a need to investigate how and why disparities for this condition exist.

Nevertheless, the tuberculosis mortality differences were not statistically significant and did not make any impact on overall mortality disparity. Recently, Wilkins et al.[31] found increasing mortality disparities for infectious diseases in Canada. One important difference between Wilkins et al.'s work and this study is the cause and age restrictions imposed in this study. For example, Wilkins et al. mentioned that the trends they observed could have been influenced by the inclusion of AIDS into the ICD9 infectious disease category. HIV was the second leading cause of death in Canadian males aged 25-44 years in 1995.[201] Wood et al.[53] recently demonstrated that low neighbourhood socioeconomic status was strongly associated with risk of HIV-related mortality in British Columbia during the period 1996-1999 (RR 2.58, 95%CI 1.71-3.89 for persons with a median income of less than $14,147 compared to persons with a median income of $14,147 or greater). Although AIDS, or any other HIV-related, deaths were not classified as avoidable per se, these findings warrant further study as deaths from HIV-related conditions could be considered avoidable.

Emphysema (ages 0-74 years)

A notable number of deaths from emphysema were observed. Although there was no apparent mortality gradient for females, males from the poorest quintile experienced almost twice as many deaths from emphysema (37) as males from the richest quintile (22) in 1996. It should be noted that this study did not classify deaths from chronic bronchitis as avoidable. Because emphysema and chronic bronchitis share many features, it is difficult to distinguish these conditions and they are often grouped into a single diagnosis of chronic obstructive pulmonary disease (COPD).[202] Therefore, classifying chronic bronchitis as avoidable may provide a better insight into the relationship between neighbourhood income and avoidable COPD-related deaths. However, the results of this study are consistent with a recent study conducted by Chen et al.,[203] who found that, for respondents of the 1994-1995 National Population Health Survey aged 35 to 64 years, household income was more strongly related to being diagnosed with chronic bronchitis or emphysema in men (aOR 3.65, 95%CI 1.90-7.01), independent of age, smoking status, number of bedrooms, household size, history of allergy, and body mass index. However the association was not significant in women (aOR 1.68, 95%CI 0.95-2.97). Chen et al. suggested that, in addition to smoking behaviours, environmental risk factors such as exposure to air pollution and occupational hazards were likely contributors to the association observed in men.

Maternal mortality (ages 0-74 years)

Considerable mortality disparity from maternal mortality was not observed. This is consistent with work done in Manitoba by Mustard et al.[34] who did not find a significant association between treatment prevalence for pregnancy complications and education (OR 0.83, 95%CI 0.67-1.02) or household income (OR 0.97, 95%CI 0.78-1.20) for women aged 15-29 years. However, each maternal death still warrants an investigation (we observed 10 deaths for 1996).[76] In British Columbia, a review of maternal deaths from direct and indirect causes occurring between 1971 and 1986 identified 31 deaths that were avoidable under ideal patient management conditions.[204]

Skin Cancer (ages 0-74 years)

There were few deaths from skin cancer in all of the years considered. However, the number of deaths in males from skin cancer increased steadily from 1971 onwards. Of the deaths that occurred, there were no remarkable socioeconomic differences. This result is consistent with a death certificate case-control study conducted by Friedman et al.,[205] that did not find a significant association between occupation-based socioeconomic status non-melanoma skin cancer mortality in the United States for the time period 1984-1995 (aOR 1.08, 95%CI 0.92-1.27 after adjusting for age, sex, race, residence and physical activity).

In a study comparing newly diagnosed British Columbian males with malignant melanoma and age- and sex-matched controls, Gallagher et al.[54] showed that risk of melanoma was strongly associated with high occupationally-based socioeconomic status (RR 3.8, 95%CI 2.0-7.4 for males in the highest socioeconomic group compared to males in the lowest socioeconomic group). Similar results were found in New Zealand, Australia, Norway and the United States.[206,207] However, Mackie et al. [208] showed that persons from more affluent areas in the west of Scotland experienced better 5-year disease-free survival compared to persons from less affluent areas (hazard ratio 0.60, 95%CI 0.46-0.77 for melanoma patients in the affluent socioeconomic category compared to the intermediate category).[208] When considered with our observations, the above noted investigations suggest that persons from higher socioeconomic groups tend to have greater risk of developing skin cancer due to sunlight exposure-related activities, but also have better skin cancer survival prospects compared to lower socioeconomic groups.

Deficiency Anaemia (ages 0-74 years)

Deaths from deficiency anaemia only occurred in 1971 (4 deaths). There was no indication of mortality disparity among these four deaths.

Asthma (ages 0-49 years)

There were no apparent disparities in asthma-related deaths. Wood et al.[35] also did not find a significant association between occupation-based measures of social status and asthma mortality in British Columbian men aged 15-64 (RR 1.5, 95%CI 0.7-3.1 for men in the lowest social group compared to men in the highest social group). However, there are various Canadian studies that suggest a relationship between asthma morbidity and social status. [42,42,43,209,210] For example, Ernst et al.[209] demonstrated that Montreal schoolchildren of parents with low occupation-based socioeconomic status were more likely to present exercise-induced bronchoconstriction (OR 2.26, 95%CI 1.12-4.58). Dales et al.[211] showed that Canadian asthmatic schoolchildren from lower income families and less educated parents were more prone to being admitted to hospital and emergency visits ($p<0.05$). Together, these studies suggest that asthma morbidity disparities exist in Canada that cannot be captured using underlying cause of death data.

Abdominal Hernia (ages 0-74 years)

Although there was an increase in deaths resulting from abdominal hernia from 1986 to 1996 time period, noticeable disparities between the quintiles were not observed. Abdominal hernia disparities will be discussed further under the section entitled *Abdominal Hernia. Appendicitis, Cholelithiasis, Cholecystits, and Cholangitis.*

4.2.2 Cause of Death Trends That Should be Interpreted with Caution

The interpretations in this section relate to chronic conditions that were likely to have not been considered the underlying causes of death. For these conditions, morbidity disparities as well as mortality disparities have been shown in other studies. Furthermore, due to the low annual number of deaths from these causes, quintile mortality gradients may not have been captured using rate ratios or rate differences. Taking these facts into account, the lack of a significant association between socioeconomic status and mortality from the following causes may be misleading and should be interpreted with caution.

Diabetes Mellitus (ages 0-49 years)

Focussing on deaths occurring at all ages, Wilkins et al.[31] observed important differences in mortality from diabetes between neighbourhood income groups in urban Canada. In their view, these mortality disparities were disquieting and warranted further study. The results of this study indicate that mortality disparities from diabetes for persons less than 50 years of age did not contribute substantially to mortality disparities in Canada. This is due in part to the fact that we restricted our analyses to deaths of those individuals less than 50 years of age (following previous work using the 'avoidable' mortality concept), which represents only a small proportion of diabetic cases in Canada. James et al.[38] observed that just over 1% of Canadians surveyed (using the 1994/1995 National Population health survey) aged 25 to 44 years reported having diabetes, whereas 10% of persons over 65 reported having the disease.

The age restrictions used in avoidable mortality analyses are intended to exclude deaths that are outside the capabilities of health care.[72] It is possible that the mortality disparities observed by Wilkins et al.[31] mainly focussed on diabetic deaths that occur in older age groups (greater than

49 years), and may be beyond the influence of current health care services. Despite this, the well documented relationship between diabetes and lifestyle risk factors, such as obesity and inactivity,[38] implies that public health has a significant role in reducing mortality disparities caused by diabetes.

In addition, mortality disparity from diabetes may not be adequately represented using vital statistics alone, as persons with diabetes tend to have other major cardiovascular health problems such as hypertension, heart disease, and cerebrovascular disease.[38] Wilkins et al.[212] demonstrated that Canadian death registrations that mentioned diabetes as a contributing cause of death were more likely to have cardiovascular diseases recorded as the underlying cause of death.

Socioeconomic mortality disparities among diabetic persons have recently been shown to exist in other countries such as the United Kingdom,[213] Finland,[214] and the Netherlands.[215] In a study conducted by Mustard et al.,[34] a significant association between diabetes treatment prevalence and education (OR 1.19, 95%CI 1.04-1.37) and household income (OR 1.32, 95%CI 1.14-1.52) was found among persons aged 30-49 years in the province of Manitoba. Recently, using hospital discharge abstracts from the Ontario Diabetes Database and physician service claims from the Ontario Health Insurance Plan database for the period 1992-1999, Booth et al.[216] found that individuals from the poorest census tracts were 44% more likely to have an avoidable diabetes-related hospitalization (admissions for hyperglycemic- or hypoglycemic-related conditions) compared to persons from the richest census tracts. Furthermore, James et al.[38] suggested that being of low income may pose serious constraints on diabetic persons' efforts to reduce the complications of diabetes.

Overall, these observations suggest that mortality disparities from diabetes do exist in Canada. However, in our view, such disparities may not be adequately observed using vital statistics alone.

Hypertension (ages 35-74 years)

Substantial differences in mortality caused by hypertensive diseases was not observed. This is at odds with a study conducted in British Columbia by Wood et al.,[35] which did find a significant association between hypertensive disease and occupation-based socioeconomic status (RR 2.9, 95%CI 1.7-5.0 for men in the lowest socioeconomic group compared to men in the highest socioeconomic group). This also contrasts with a study by Roos and Mustard,[39] which found a significant ($p<0.01$) linear trend in standardized deaths rates from hypertension across neighbourhood (enumeration area) income groups in urban Manitoba. The fact that the results of this study do not coincide with Wood et al.'s and Mustard and Roos' results could be due to various analytical differences between the investigations. For example, Wood et al. applied individual-level occupational measures of socioeconomic status, whereas urban area-level income measures were considered here. In addition, Wood et al. considered all male deaths in British Columbia between the ages of 15 to 64 years and Roos and Mustard considered the mortality in urban Manitoba among persons up to 74 years of age. The analyses of this study were restricted to deaths from hypertension between the ages of 35 to 74 years. Although we examined rate ratios in a similar manner to the Woods et al. study, we were only able to consider deaths over a 1-year period, whereas Wood et al. observed deaths over a 10-year period. Also, a linear trend across income groups was not calculated as was done by Roos and Mustard. Finally, it must be taken into account there may exist provincial differences in mortality disparity from hypertension that are not observable through a study conducted at the national level.

Hypertension is an important cardiovascular mortality risk factor and may be underrepresented as an underlying cause of death in vital statistic databases. For example, Wilkins et al.[212] demonstrated that Canadian death registrations that mentioned hypertensive diseases as a cause of death were more likely to cite other cardiovascular diseases as the underlying cause of death. That being said, recent evidence shows that, in Canada, there are no socioeconomic differences in the prevalence of hypertension or knowledge about hypertension as a cardiovascular disease risk factor.[217,218]

4.2.3 Other Causes

For some of the conditions discussed in the following section, our results are in agreement with those found elsewhere. However, for other causes, very little research has been conducted in Canada on mortality disparities related to these conditions. It can be noted with confidence that there is, in fact, little mortality disparity related to these causes. The quintile SEYLL rates, Q5-Q1 and QT-Q1 rate differences and rate ratios, as well as the standard errors for the measures are presented for all of the condition considered for this study in Appendix D.

Uterine Cancer, Testicular Cancer, Leukaemia and Hodgkin's Disease

These causes have been studied together in other studies comparing cancer incidence, survival and mortality rates between socioeconomic groups.[35,36,184,219] These studies did not find a significant association between socioeconomic status and mortality attributed to these causes. For example, Gorey et al.[219] did not find a significant link between neighbourhood income and incidence of Hodgkin's disease or Leukemia among residents of Toronto aged 25 years and older during the 1986-1993 time period. Examining cancer cases diagnosed between 1987 and 1992 from the Ontario Cancer Registry, Boyd et al.[184] did not find a significant association between neighbourhood income and survival rates attributed to uterine cancer, testicular cancer or Hodgkin's disease for cancer patients over 20 years of age.

Chronic Rheumatic Heart Diseases (ages 0-74 years)

This study did not find a significant association between socioeconomic status and mortality from chronic rheumatic heart disease. Wood et al.[35] also did not find a significant association between occupation-based social status and deaths from rheumatic heart disease among British Columbian men (RR 1.3, 95%CI 0.5-3.7 for men in the lowest social group compared to men in the highest social group).

Hernia, Appendicitis, Cholelithiasis, Cholecystits, and Cholangitis

Similar to our findings, Wood et al.[35] also did not find a significant association between hernia, appendicitis and cholecystitis mortality and social class among British Columbian men. In another study conducted in the United Kingdom, Kennedy and Jones[220] were unable to find a relation between occupation-based socioeconomic status and the prevalence of choelcystectomy, prevalence of irritable bowel syndrome, or consultation for symptoms of irritable bowel syndrome. The findings of the above noted studies suggest that there does not exist substantial disparities for these conditions.

Epilepsy (ages 0-74 years)

Socioeconomic mortality differences attributed to epilepsy have not been studied previously in Canada. Although epilepsy mortality differences between socioeconomic groups were not found, morbidity disparities have been shown to exist in other studies.[221-224] In England, for example, it has recently been demonstrated that residents from socioeconomically deprived enumeration districts experienced a greater incidence of epilepsy (incidence rate ratio 2.33, 95%CI 1.46-3.73 for the most deprived population compared to the least deprived population).[223] Also, using a United Kingdom national survey of morbidity and general practice among patients with epilepsy, Gaitatzis et al.[224] found that patients from lower occupational classes had a higher number of hospital consultations (9.7 per person in the lowest social class) compared to other classes (8.31 per person in the highest social class). Furthermore, after combining family interviews, physician reports and health records of adolescents (11 to 17 years of age) with epilepsy in the United States and Canada as a means of examining potential risk factors for health-related quality of life (HRQOL), Devinsky et al.[221] found that individuals living in households of lower socioeconomic status were more likely to report poor overall HRQOL.

Peptic Ulcer (ages 0-74 years)

Twice as many individuals in the poorest quintile died with peptic ulcer as the underlying cause of death (20) compared to the richest quintile (9). However, a death from peptic ulcer was not considered an "unnecessary untimely death" by Rutstein et al.[76,102] and the quintile mortality differences were not statistically significant.

Overall, there has been very little research done on peptic ulcer disparities in Canada. In one Canadian study examining data from the 1994 National Population Health Survey to determine if exposure to domestic pets was associated with a history of peptic ulcer disease, McIsaac and Leung[225] observed that persons with more education (OR 0.34, 95%CI 0.26-0.44) and household income (OR 0.43, 95%CI 0.33-0.55) were less likely to report a history of peptic ulcer disease compared to persons with less education and household income. A higher peptic ulcer prevalence has also been observed in persons from lower socioeconomic groups in the United States and Australia.[226-228]

Nephritis and Nephrosis (ages 0-74 years)

Overall, the number of deaths in urban Canada from nephritis and nephrosis doubled from 1971 (204 deaths) to 1996 (433 deaths). In addition, in 1996, there were noticeably more deaths in the poorest quintile (130) compared to the richest quintile (69). Deaths attributed to nephritis and nephrosis were not considered "unnecessary untimely deaths" by Rutsein et al. Previous studies examining social factors related to nephritis and nephrosis have focused on differences between ethnic groups.[229] The relationship between socioeconomic status and nephritis and nephrosis has not previously been studied in Canada.

Ileus without Hernia, Infections of the Urinary System, Hyperplasia of the Prostate and Congenital Digestive Anomalies (ages 0-74 years)

For these conditions, there was a very small number of deaths in all of the years considered. Relevant studies relating socioeconomic status to these causes of death in Canada were not found in the literature.

4.4 Mortality Disparities Among Men and Women

Wilkins et al.[31] showed that differences in life expectancy between the richest and poorest quintiles in urban Canada were greater for men than women (about 5 years for men and 1.6 years for women in 1996). When examining aggregated and cause-specific 'avoidable' mortality inequalities, we observed that women generally experienced smaller absolute and relative disparities in mortality than men. However, quintile mortality ratios for ischaemic heart disease indicated greater relative disparities in women for almost all of the time periods considered.

Worthy of note is that Mackenback et al.[230] found similar results when comparing sex-specific relative mortality disparities based on occupational measures of socioeconomic status in the following seven countries: the United States, Finland, Norway, Italy, the Czech Republic, Hungary, and Estonia.

Koskinen and Martelin[231] purported that differences in the relative contribution that each condition makes to the total incidence of mortality assists in explaining why women show smaller socioeconomic differentials. Of all the causes considered in this study, ischaemic heart disease, lung cancer, perinatal mortality and cerebrovascular disease were the greatest contributors to mortality disparity for both men and women. These causes are among the leading causes of premature mortality for men and women in Canada.[98,201] However, it is important to note that breast cancer is also a major cause of death in Canadian women and the richer quintiles experienced greater mortality from this cause.[31,232]

Previous studies have had difficulty ascertaining the factors that contribute to sex differences in mortality inequality. Education- and income-related disparities in lifestyle risk factor are similar among Canadian men and women.[217,233] Matthews et al.[234] found few gender differences in socioeconomic health inequalities among a 1958 birth cohort born in England, Wales and Scotland. Matthews et al. did note, however, that gender differences in health inequalities varied by measure of socioeconomic status (occupation or education), age (23 versus 33 years of age) and health outcome. Socio-demographics may influence the sex differences in mortality inequality. For example, Koskinen and Martelin[231] demonstrated that the differences in socioeconomic mortality disparities between men and women existed only within the married subpopulation of Finland. Single, widowed and divorced women experienced mortality inequalities that were as large as those of men. It has been suggested that varying work and home environments may have differing impacts on socioeconomic inequality between men and women.[234,235] Overall, however, the mechanisms affecting gender differences in mortality inequality are poorly understood.

Chapter 5 Limitations

5.1 'Avoidable' Mortality As an Indicator of Health Care Performance

Despite its application in many countries, the validity of the 'avoidable' mortality (AM) as an indicator of health care performance has been questioned in the literature. The purpose of this section is to describe some shortcomings related to AM data analyses and outline weaknesses associated with the AM concept.

5.1.1 'Avoidable' Mortality Data

Although death is an understandable outcome and mortality data are readily available, there are some important limitations that should be taken into account when reviewing studies that are based on mortality data. Many of these limitations are reviewed in Appendix C. In this section, shortcomings of mortality data that are relevant to the AM concept will be presented.

Mortality statistics are derived from the information recorded on death registrations. However, a considerable proportion of death registrations have been shown to contain inaccurate information. For example, in a recent audit of death certificates completed by residents of a Canadian teaching hospital in 1995, Myers and Farquhar[236] found that 32.9% of the certificates contained at least one major error.

Selecting a single underlying cause of death tends to bias mortality statistics when multiple pathologies were present at death. For example, certain causes of death (such as lung cancer, breast cancer and leukemia) have been shown to usually be recorded as the underlying cause of death when the disease was present shortly before death, while others (such as asthma and anaemia) are rarely recoded on death certificates.[153,237,238] Conditions such as diabetes mellitus and hypertension tend to be mentioned on the death certificate, but not classified as the underlying cause of death.[153,237] Also, due to common risk factors shared by some causes of death, there are competing causes of death that tend to be mentioned together on death certificates. Therefore the contributions of some avoidable diseases are underestimated when only considering the underlying cause of death. Although it may be reasonable to make determinations about the mortality trends of certain conditions (such as lung cancer), it may be inappropriate to do so for others (such as hypertensive disease and diabetes mellitus).[153,237-239]

5.1.2 'Avoidable' Mortality Concept

There are several weaknesses associated with applying the AM concept in practice. First, there have been inconsistencies in the classification of avoidable deaths. Although most AM studies refer to the Rutstein et al. list of "sentinel health events",[76,102] they generally omit causes of death if they are infrequent or lie outside the capabilities of the health care system.[73] The differences in avoidable death classifications may also reflect differences of opinion on the possible influence of health care on mortality. The choice of conditions as well as the age ranges for which deaths are considered avoidable is presently arbitrary. The reasons for including or excluding causes of death are usually not mentioned in investigations, and published studies rarely review evidence supporting the avoidable causes they selected.[73]

Second, many investigators have questioned the analytic assumption that all deaths from the selected avoidable deaths could have been avoided by optimum health care and all "non-avoidable" deaths were inevitable. Some deaths that were classified as avoidable may in fact have been unavoidable due to the presence of other diseases or complications during treatment.[93,101] Furthermore, health care must have delayed some proportion of deaths from non-avoidable causes. For example, deaths from human immunodeficiency virus (HIV)-related diseases can be considered avoidable through public health initiatives such as education and through medical care interventions such as highly active antiretroviral therapy (HAART).[53,201] Recently, HIV-related mortality and access to HAART have been shown to be strongly associated with socioeconomic status in British Columbia (p=0.003).[53] However, none of the AM studies considered in this study classified HIV-related deaths as avoidable.

Third, vital statistic databases do not provide information about disease incidence, environmental exposures, risk factors, disease severity, or factors encountered in the health care setting. Without information regarding the pre-existing factors that could have influence the AM levels, it is difficult to determine the performance of particular areas of health care using AM statistics. For example, differences in AM levels may be due to variations in disease incidence or differences in case fatality.[73,83,93,240] Disease incidence may indicate the quality of preventive initiatives, whereas case fatalities may be more related to the quality of medical interventions. In addition, there are many important aspects of heath care that cannot be measured using mortality statistics. AM studies focus on the curative aspects of health care rather than on treatments aimed at reducing morbidity and improving quality of life, such as mental counselling, limb replacement, and pain relief.[83,105]

Fourth, AM levels are believed to reflect health care performance. This concept depends on evidence that AM statistics are sensitive to the quality of or access to health care services.[118] However, AM studies rarely incorporate health care service measures to validate whether the mortality levels actually reflect the quality of care.[73] Furthermore, a meaningful association between AM levels observed and health care performance and accessibility is lacking.[73,118] Thus the validity of AM as an indicator of health care effectiveness is unproven.

In sum, caution is required when interpreting AM analyses. As proposed by Rutstein et al.,[76] and reinforced by others,[73,83,241] AM trends are a very useful tool for monitoring the effectiveness of health services, but should be limited to signalling where future in depth studies are required.

5.2 Mortality Indicators

Years of life lost rates were calculated to indicate premature mortality. The method of calculating years of life lost assumes that the deaths within a specific age group are uniformly distributed across that age group. Since 5-year age groups were used, this assumption is reasonable.[8] This method also assumes that if a person did not die of one cause, he or she would not die from any other cause before reaching the cut-off age. This assumption ignores competing risks of death.[155,242,243] Although deaths at ages 75 years and older were excluded (ages when assigning a single cause of death are most problematic), competing risks for deaths less than 75 years of age could not be accounted for. Lai and Hardy[243] recently argued that calculating the change in life expectancy by deleting cause-specific deaths from standard life tables would provide a better impact measure of premature mortality because this method mathematically accounts for competing risks. However, Mackenback et al.[239,244] demonstrated that these life table methods do not account for dependent competing risk and therefore also produce biased results. Furthermore, the ranking of premature causes of death using years of life lost and life table methods have been shown to be comparable.[155,245]

The choice of the years of life lost age limit influences the value placed on deaths in different age groups (a comparison of EYLL and PYLL is presented in Appendix B). In order to determine sensitivity of the results, the contribution of 'avoidable' causes to all cause QT-Q1 EYLL, SEYLL, PYLL, SPYLL and ASMR differences were compared. There were marginal differences between the years of life lost calculations. An ASMR-based ranking was also similar to the years of life lost ranking for the major contributing causes of mortality disparity. This suggests that the avoidable causes that contributed the greatest to mortality disparity in urban Canada were correctly identified.

For certain causes of death, such as hypertension and diabetes, low annual death counts may have prevented the observation of significant mortality disparities. Previous avoidable mortality studies have addressed this issue by aggregating deaths from consecutive years.[35,73,99] Unfortunately, because deaths were coded to census tracts only for the years 1971, 1986, 1991 and 1996, this study was unable to aggregate deaths from consecutive years.

5.3 Area-Based Measures of Socioeconomic Status

The limitations associated with area-based measures of socioeconomic status (SES) may have introduced bias. First, this study could only ascribe neighbourhood socioeconomic status accurately for non-institutional residents of urban areas. The sociodemographics of non-institutional and urban populations may be different from other populations and the relationships we observed may not be generalizable beyond the populations we studied.[31,60] However, analyses conducted for this study were restricted to deaths under 64 years of age for five out of the seven classification lists considered and deaths under 74 years of age for the other two classification lists. Greater that 90% of the deaths of persons resident in institutions were over 64 years of age in all of the years considered in this study (93% of male and 98% of female deaths for 1996) and 80% of the deaths were over 74 years of age (79% of male and 92% of female deaths for 1996).

Given that income-related differences avoidable SEYLL decreased consistently from 1971 to 1991 for almost all classification lists, it seems that if including deaths of institutional residents was possible, it would not have made a major impact on the results of this study. Furthermore, the results of other Canadian studies suggest that the our observations are not limited to residents in urban areas or to non-institutional residents.[3,34,39-41,55,57]

Second, censuses may not cover all socioeconomic groups equally. Lower socioeconomic groups tend to be undercovered and this undercoverage is believed to have increased over time.[30,31] The net effect of this under-coverage would be to overestimate the association between SES and mortality, since it produces reduced estimates of poor populations and therefore increased estimates of their mortality rates.[31,125] Applying correction factors based on the reverse record check to the same population data that was utilized in this study, Wilkins et al.[30] determined that accounting for census under-coverage reduced the 1986 difference in life expectancy between the richest and poorest quintiles by 0.5 years, a 9% reduction for males and 28% reduction for females. The impact of this undercoverage has not been quantified for the other years considered in this study.

A third potential bias involves "ecologic fallacy", where associations between variables on the aggregate-level are incorrectly used to make inferences at the individual level.[123,125,154] Although area-level data was used to characterize individuals living in those areas, the census tract methodology we used may not be subject to classic ecological fallacy.[41,124,125] Inferential fallacies can be avoided by ensuring that the inferences made are congruent with the data and analyses applied to make them.[123,137] As noted by Wilkins[31,60], and others[41,124-126,246], the purpose of this study was to examine neighbourhood income-related mortality trends, and not to infer these trends to what would be observed at the individual income level.

Fourth, the socioeconomic composition of neighbourhoods in urban Canada may have changed over time in a manner that was not accounted for in our analyses. For example, one possibility is that poor persons increasingly moved into richer census tracts from 1971 to 1996. If this did occur, it would have led to a reduction in the observed neighbourhood mortality inequality, even without any changes in mortality rates at the individual level.[60] However, residential SES segregation in metropolitan Canadian cities has been shown to have increased from 1980 to 1995.[247]

Fifth, decedents' SES were inferred based on the characteristics of the neighbourhood where they lived at the time of their death. It has been suggested that SES be measured at various stages of peoples' lives in order to understand how health outcomes are related to different socioeconomic positions people experience throughout their lifecourse.[125,248,249] Although some authors have proposed that the effects of childhood SES on adult mortality are mostly indirect and mediated through their influence on SES later in life,[7,125,248,249] childhood poverty has been shown to lead to increased risk of poor health independently of its association with adult SES.[125,248-250] This implies that SES measured one point of the lifecourse should be interpreted with this perspective.

5.4 Census Metropolitan Area-Based Versus Nationally-Based Income Quintiles

Neighbourhood income quintiles were derived by first ranking census tracts within census metropolitan areas (CMAs) according to the percentage to their population below the Statistics Canada low-income cut-offs (LICOs) and then designating census tracts into 5 groups from lowest to highest percentage of low-income residents. LICOs measure income adequacy and adjust for family as well as community population size. However LICOs do not adjust for differences in living costs between metropolitan areas. Quintiles were determined within CMAs and then pooled across CMA in an attempt to adjust for the differences in living costs between CMAs.

Another approach could have been to rank the census tracts nationally and then to designate quintiles. This would ensure that the populations designated into the same quintiles resided in census tracks with a similar proportion of residents below the LICO. Using the same data analysed for this study, Wilkins et al.[30] demonstrated that, for 1986, 36% of metropolitan Toronto would have been designated into to the first nationally-based quintile and 4 CMAs in the eastern Canada (St. John, Chicotimi-Jonquière, Sherbrooke and Trois-Rivières) would have no population in that quintile. Wilkins et al. also found that the differences in life expectancy between the richest and poorest nationally-based quintiles for 1986 was 0.4 years (11%) less than the difference between the CMA-based quintiles. This suggests that the quintile measure that adjusts for CMA differences in living costs is more relevant for describing mortality differences.

Courteau and Trempe[251] compared mortality by neighbourhood income between the Outaouais region and other CMAs in Quebec (Montreal, Quebec, Sherbrooke, Chicoutimi-Jonquière and Trois-Rivières). When determining quintiles by ranking census tracts provincially, they found that although 26% of the Outaouais population were in the richest quintile and only 12.4% in the poorest quintile in 1986, the Outaouais region experienced 12% greater mortality compared the other Quebec CMAs ($p<0.001$). The authors attributed this finding to the fact that 85.8% of the Outaouais regions' population were the in the poorest 3 quintiles for the Ottawa-Hull CMA. This suggests that relative income differences (within CMAs or regions) are more important determinants of mortality compared to absolute differences.

5.5 Measures of Mortality Disparity

To measure absolute and relative mortality disparities, we utilized rate differences (RDs) and ratios (RRs). These measures ignore parts of the information available. More sophisticated measures, such as the index of dissimilarity and the regression-based relative effects index, incorporate more information by including the association between socioeconomic status (SES) and mortality among all of the quintiles. These methods have not previously been applied to years of life lost mortality indicators. Also, these methods place restrictions on data and are more likely to be misinterpreted.[158] Many recent studies examining mortality disparities have focused on mortality RR and RDs.[8,10,15,24,29,31,35,171,252,253] Furthermore, it has been argued that RDs and RRs provide more meaningful information regarding the magnitude of mortality inequalities for policy-makers.[60,158]

Although the results of this study are only presented with respect to comparisons between the poorest and richest quintiles (Q5-Q1), these trends were very similar to what was observed when the total population was compared to the richest quintile (QT-Q1). As shown in Appendix B, this is mainly due to the notably greater mortality experience in the poorest quintile compared to the other quintiles.

5.6 The Health Selection Hypothesis

The direction of the association between neighbourhood income and AM levels cannot be determined by our analyses. The "reverse causality" or "health selection" hypothesis argues that people with poorer health are more likely to have lower earnings and die earlier in life. In this way, socioeconomic differences in health and mortality may due to the selection of relatively unhealthy people into lower social groups.[254]

Although there has been considerable debate over the importance of health selection for explaining socio-economic disparities in health, very little research of this nature has been conducted in Canada. In one Canadian longitudinal study examining the trends in survival probability between the ages of 65 and 74 years by average income for 545,769 male beneficiaries of the Canada Pension Plan who attained 65 after September 1, 1979, Wolfson et al.[3] argued that health selection had only a small impact on the mortality differences they observed by referring to 3 observations. First, when only considering the subset of the study population who had statistically significantly ($p<0.05$) increasing earnings between 1966 to retirement, the survival probability gradients in relation to average income persisted: the probability of surviving to age 74 was 0.77 for the poorest quintile and 0.81 for the richest quintile. Second, clear age- and marital status-adjusted mortality gradients were evident for each age group (53 to 65 years) who retired at the same age. Wolfson et al. noted that in order to the health selection effect to be the main reason for this observation, there must have been a variety of conditions that (a) were incident by the latest 45 to 50 years, (b) were disabling, but not fatal nor seriously disabling up to age 65, and (c) caused higher mortality between the ages of 65 and 74. Third, Wolfson et al. showed that adjusting for individual earnings time-trends (which demonstrated a strong positive correlation with survival), the magnitude of the effect of average income on mortality did not change (Weibull regression coefficients of 0.0315 and 0.0353 with and without the adjustment, respectively).

Several studies outside of Canada have examined the impact of health selection using different approaches. One method has been to adjust for initial health status (the health status of individuals prior to the observation period).[255] These studies have shown that adjusting for initial health status reduces the strength of the association between income and health, but the adjusted association remains significant. For example, in the United States, McDonough et al.[256] examined data from the nationally representative sample for the Panel Study of Income Dynamics for the years 1968 to 1989 in order to examine the impact of income changes on mortality. McDonough et al. found that the income gradients in mortality for persons greater than 45 years of age persisted after adjusting for initial work-related disability (adjusted odds ratio between the lowest and highest income levels of 3.89, 95%CI 2.56-5.82 and 2.39, 95%CI 1.53-3.64 before and after including disability and education into the regression equation).

Analyzing data from a representative sample of adults from the Alameda County, California for the years 1965, 1974, 1983 and 1994, Lynch et al.[257] studied the relationship between the number of times that subjects reported total household incomes that were less than 200% the federal poverty level (economic hardships) between 1965 and 1983 and their measured functioning in 1994. When examining the plausibility of reverse causation as an explanation for their observations, they performed restricted analyses on subjects who reported excellent or good health in 1965 and whose income was not derived from wages or salaries. Lynch et al. reasoned that illnesses were less likely to create economic hardships for this sample because their sources of income did not depend directly on their health status. They found a graded association between the number of economic hardships and self-reported reduced physical functioning (odds ratios of 1.59, 3.48 and 5.91 for 1, 2, 3 economic hardships compared to none between 1965 and 1983) and reduced psychological functioning (OR 2.18, 4.06 and 6.02) that were similar to the patterns they observed in the whole sample.

Thiede and Traub[258] analyzed data from the German Socioeconomic Panel household survey (8,489 persons surveyed) for the years 1992 and 1994 to examine the association between change of household income over the 2-year period and health related quality of life. Thiede and Traub showed that although self-reported handicap, need of care and optimism in 1992 were significantly ($p<0.05$) associated with income change, they were only able to explain 3% of the overall variance in income changes. This study had a short follow-up period and the authors noted German legislation enforces the continuation of payments for sick employees, which can partly explain the above observations. However, household income changes were also significantly associated ($p<0.05$) negatively with need of care and loneliness, and positively with optimism in 1994.

An important question remains: to what extent can sicioeconomic differences in health be explained by health selection? Chandola et al.[254] recently attempted to answer this question using data from the Whitehall II longitudinal study of 10,328 male and female civil servants in the United Kingdom. Analyzing data for the years 1985-1988, 1991-1993, 1995-1996 and 1997-1999, Chandola et al. developed structural equation models that could account for changes in employment grade and changes in health mental and physical health (as measured by the General Health Questionnaire) between each time period. Chandola et al. found that removing the paths for health selection increased the chi-square significantly (chi-square=15.2 on 4 degrees of freedom, p<0.01) for their model of financial deprivation and mental health. On the other hand, the increase in chi-square when the social causation (socioeconomic status affects health) paths were removed from the model was much greater (chi-square=158.9 on 4 degrees of freedom, p<0.001). Similar results were obtained for the physical function health status measure. Chandola et al. estimated that the effect of social status on health was between 2.5 and 3 times greater than the health selection effect.

In sum, studies that have investigated the impact of health selection on socioeconomic health and mortality inequalities have consistently concluded that although health selection does account for some of the association, health selection (a) cannot explain the observed relationship alone and (b) likely contributes to a small extent. The magnitude of impact has not been studied in the Canadian context.

5.7 The Healthy Immigrant Effect

This study was unable to identify residents who were not born in Canada. Chen et al.[259] demonstrated that Canadian immigrants, particularly recent immigrants, experienced lower mortality rates compared to Canadian-born persons during the periods 1985-1987 and 1990-1992. This has been attributed to various factors, including that healthier people are more likely to emigrate, Canadian immigrant selection policies favour healthier applicants, and immigrants are more likely than the Canadian-born populations to have never smoked.[147,259] Wilkins et al.[30] showed that in 1986, the proportion of the population born outside of Canada was 26% for poorest quintile (Q5) and 18% for richest quintile (Q1). From 1986 to 1996, the proportion of persons born outside of Canada diminished for Q1 (to 16%) and grew in the poorer quintiles (34% in Q5).[31] Since the poorer quintiles include a larger proportion of immigrants who tend to have lower mortality rates compared to Canadian-born persons, by including persons not born in Canada likely attenuated the neighbourhood SES mortality disparities that would have been observed if they were excluded. In a study examining mortality trends by neighbourhood income in Canada, Wilkins et al.[30] estimated that for 1986, the net effect of excluding all persons not born in Canada from both death and population counts was to increase life expectancy difference between the richest and poorest quintiles by 1.1 years. Nevertheless, it has been argued that the observed differences in mortality among socioeconomic quintiles reflect mortality differences in Canada, immigrants inclusive. Determining the effect of excluding persons not born in Canada would compliment the observations of this study.

Chapter 6 Implications for Health Policy and Future Research

Neighbourhood income differences in mortality amenable to medical intervention diminished substantially in both men and women from 1971 to 1991. From 1991 to 1996, disparities in mortality amenable to medical care continued to decrease in women but showed little change in men. Differentials in mortality amenable to public health decreased consistently from 1971 to 1996 for men but did not change for women. When examining individual avoidable causes of death, there is evidence of clear gains, and unfortunate failures in attempts to reduce mortality disparity in Canada. For example, while mortality disparities related to deaths from cirrhosis of the liver and cervical cancer were in decline for males and females, mortality inequality from lung cancer has shown little improvement in males, and has in fact has been increasing in females. In addition, although disparities in mortality from perinatal conditions have decreased substantially from 1971 to 1991, such disparities have increased in males from 1991 to 1996. Mortality disparity from cerebrovascular disease has not diminished notably since 1991.

In the United States, Wong et al.[21] found that the leading contributors to educational life-year disparity included ischaemic heart disease (11.7%), lung cancer (7.7%), pneumonia (5.1%), and hypertension (3.3%). Similar to Wong et al., this study attempted to identify conditions that contributed the most to mortality disparities in order to suggest that targeting these causes would have greatest influence on reducing mortality disparities in Canada.

In the following section, the implications of our findings for health policy are described and recommendations for future research are made.

6.1 Health Policy

6.1.1 Access to Medical Care and Quality of Services

By 1996, there were no remarkable mortality disparities for many of the causes of death amenable to medical intervention. These conditions include some infectious diseases, skin cancer, Hodgkin's disease, epilepsy, asthma, female breast cancer, peptic ulcer and maternal mortality. Furthermore, for those medically amenable causes that were found to contribute noticeably to absolute years of life lost disparity (such as cervical cancer, pneumonia and perinatal conditions) absolute mortality disparities have decreased consistently since 1971. This suggests that medical care has made important contributions to reducing mortality disparities in Canada.

This observation is supported by investigations that have failed to demonstrate socioeconomic differences for medical intervention waiting times[63] or hospital utilization patterns.[260] Although Canadians of lower socioeconomic status were more likely to visit physicians more frequently,[64-68] and spend more days in the hospital,[68,260] this occurrence seems to be based on health need, as measured by perceived health status or condition severity.[39,65,66,68,260]

Nevertheless, large mortality disparities from ischaemic heart disease and cerebrovascular disease indicate that medically amenable mortality disparities do persist in Canada. Indeed, persons from lower socioeconomic groups have been shown to be less likely to see a general practitioner, or be referred to a specialist.[66,67] The Alter et al.[55,56] and Kapral et al.[57] studies have shown that Ontarians from lower-income neighbourhoods were less likely to receive health services for acute myocardial infarction and stroke, respectively. However, it must be noted that in both studies, lower-income was associated with mortality independently of medical service characteristics, suggesting that patients of lower socioeconomic experience greater disease severity due to factors stemming from outside the medical care setting.

6.1.2 The Future of Public Health in Reducing Socioeconomic Mortality Disparities

The existence of large mortality disparities for ischaemic heart disease, lung cancer, perinatal mortality, cerebrovascular disease, and cirrhosis of the liver (in males only) support the contention that public health initiatives will have a strong role to play in reducing mortality inequalities in Canada.[31,39,60] Although perinatal mortality is traditionally considered an indicator of medical care performance, recent evidence suggests that the increases in mortality disparity in recent years may be more related to maternal behavioural and psychosocial risk factors.[58,167,169,171-173] Furthermore, the unchanging socioeconomic gradients in mortality from some of these causes (lung cancer and cerebrovascular disease in males and ischaemic heart disease in females) as well as the widening inequalities for other causes (perinatal conditions and lung cancer in females) present a warning sign to the Canadian public health system.

The observation noted above follow repeated recommendations put forth by many authors contending that future health policies should target preventive health interventions, and protective social programs, to address the risk factors that mediate the impact of socioeconomic status on health.[34,39,162,188,188,196,261] Indeed, there exist remarkable socioeconomic differences in individual risk factors such as smoking, sedentary living, poor diet, obesity, stress and physical inactivity. Knowledge about these risk factors has also been shown to differ between socioeconomic groups in Canada.[177,217,218,233,262] Moreover, recent studies have highlighted the effects of neighbourhood environments on health. The results of these investigations suggest that health policies should focus not only on individuals, but also on the communities in which people live.[124,138-140,142,163,263-266] Innovative social policies as well as targeted public health interventions will be required to ensure progress in diminishing socioeconomic disparities. Also, to ensure Canada continues to make progress towards "Health for All", it will be important to closely monitor socioeconomic health differentials, as well as the effectiveness of interventions aimed at reducing them.[60]

6.2 Future Research

The cause and age groups selected to classify 'avoidable' deaths vary considerably between studies. Future research in Canada using the avoidable mortality (AM) concept should carefully consider the criteria used to define AM trends. Such studies should examine causes of death which provide meaningful insight into the influence of health care on mortality, taking into account both conceptual (i.e. causes of death that are sensitive to health care performance and accessibility) and practical (i.e. data quality and availability) factors.

A logical follow up to a nationally based study would be to investigate provincial trends in AM disparities. In order to facilitate comparisons, similar methodology should be adopted in conducting such AM studies. This may include using standard avoidable causes and analyses.

Since Canadians are more likely to die with multiple chronic conditions, we cannot be confident in the underlying cause of death trends for some causes of death, such as diabetes and hypertension. Multiple causes of death statistics and follow-up studies will better enable investigators to observe mortality trends among Canadians. Furthermore, there are important avoidable morbidity differences between socioeconomic groups that have not been captured in this study. Future research should attempt to describe and understand such differences.

Incorporating population attributable risk methods to the avoidable mortality trends may provide insight into the potential impacts of reducing risk factor disparities in Canada. For example, comparing the potential impacts of reducing cholesterol levels, obesity or smoking on mortality disparity could indicate the direction in which future health policies should be heading.

Future studies examining the validity of AM as an indicator of health care performance should utilize health care variables that specifically focus on (a) how health care services are supplied, (b) their conformity to quality standards, and (c) their accessibility. Excellent examples that illustrate how the relationship between deaths and health care variables can be evaluated are found in the studies performed by Kapral et al.[57] and Alter et al.[55,56] These studies examined information from hospital discharge databases, which include data regarding patient, physician and hospital characteristics, linked to individual vital status to determine whether socioeconomic differentials in mortality were the result of differences in access to specialized health care services.

It is important to identify the underlying processes that result in the persisting and widening socioeconomic mortality differentials we observed, so that future policies and programs can effectively reduce or eliminate them. Although previous longitudinal studies conducted in other countries have found insights into the mechanisms mediating socioeconomic mortality disparities,[138,139,142,263] such work has not yet been performed in Canada. Longitudinal studies of individual-, family-, and area-level measures of socioeconomic status (such as income, education level, and occupational history, ethnicity, language, disease incidence, disease progress, and morbidity) would contribute to a better understanding of the long-term processes affecting health.[31,92,250] These studies should also consider whether health disparities originate principally in childhood, or are primarily attributable to exposures and circumstances occurring in adult life.[7,34,125,248-250]

In the absence of such data, vital statistics can be linked to various sources of information, such as census databases, health surveys, taxation records and administrative databases, as a means of connecting socioeconomic and other relevant variables to mortality in Canada.[31,60] Using this approach, Veugelers et al.[59] examined the influences of neighbourhood as well as individual socioeconomic characteristics on mortality in Nova Scotia. Multilevel analytic approaches such as this one can provide insight into the differing and synergistic effects of individual and contextual factors mediating socioeconomic disparities in health.

Additional clues to understanding the potential reductions in socioeconomic health inequalities may lie in understanding the differences in health disparities between males and females.[34]

6.3 Conclusion

Neighbourhood income-related differences in AM diminished substantially in both urban Canadian men and women from 1971 to 1996, irrespective of which avoidable deaths classification list was considered. While absolute disparities in mortality amenable to medical intervention and public health decreased from 1971 to 1996, differences in mortality not considered avoidable decreased marginally in women and increased in men. These results suggest that medical care and public health have contributed to reducing mortality disparities in urban Canada over this 25-year period.

When examining avoidable deaths by cause, ischaemic heart disease, lung cancer, perinatal conditions, liver cirrhosis (in males only), and cerebrovascular disease contributed the greatest amount to absolute years of life lost disparity in 1996. For most of the avoidable causes that contributed noticeably to absolute mortality disparity in 1996, mortality inequalities have diminished consistently over time. However, mortality inequalities for some causes (lung cancer and cerebrovascular disease in males and ischaemic heart disease in females) have not shown consistent reductions, while for other causes (perinatal conditions and congenital cardiovascular anomalies in males and lung cancer in females) inequalities have widened. The trends in avoidable mortality disparities related to these causes present a warning sign of possible shortcomings in the Canadian health care system that warrant further study.

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Appendix A Avoidable Deaths Classification Lists

Table A.1: Charlton 1983

Cause	ICD8 Code	ICD9 Code	Age Group
Hypertensive disease	400-404	401-405	5-64
Cancer of cervix uteri	180	180	5-64
Pneumonia and bronchitis	480-486, 490	480-483, 485-486, 490	5-49
Tuberculosis	010-019	010-018, 137	5-64
Asthma	493	493	5-49
Chronic rheumatic heart disease	393-398	393-398	5-44
Acute respiratory disease	460-466, 470-474	460-466, 487	5-49
Bacterial infections	004, 034, 320, 381-383, 390-392, 680-686, 710, 720	004, 034, 320-322, 381-383, 390-392, 680-686, 711, 730	5-64
Hodgkin's disease	201	201	5-34
Abdominal hernia	550-553	550-553	5-64
Acute & chronic cholelithiasis and cholecystitis	574-575	574-575.1, 576.1	5-64
Appendicitis	540-543	540-543	5-64
Maternal deaths	630-678	630-676	10-44
Deficiency anemias	280-281	280-281	5-64
Perinatal deaths	760-779	760-779	--

Table A.2: Poikolainen 1986

Cause	ICD8 Code	ICD9 Code	Age Group
Enteritis and other diarrhoeal diseases	008-009	008-009	0-64
Tuberculosis	010-019	010-018, 137	0-64
Syphilis	090-097	090-097	0-64
All other infectious and parasitic diseases, Including otitis media, mastoiditis, skin infections, osteomyelitis, and periostitis	000-006, 020, 022, 033-034, 037, 040-044, 050, 060, 098, 126, 381-383, 680-686, 720	001-006, 020, 022, 033-034, 037, 045 050, 060, 098, 126, 381-383, 680-686, 730	0-64
Malignant neoplasms of the cervix uteri	180	180	0-64
Diabetes mellitus	250	250	0-49
Hodgkin's disease	201	201	5-64
Goitre, thyrotoxicosis, avitaminoses and nutritional deficiencies	240-242, 260-269	240-242, 260-269	0-64
Epilepsy	345	345	0-64
Active rheumatic fever	390-392	390-392	0-64
Hypertensive disease	400-404	401-405	0-64
Acute respiratory infections, influenza and pneumonia	460-486	460-486	0-49
Bronchitis, emphysema and asthma	490-493	490-493	0-49
Peptic ulcer	531-533	531-533	0-64
Appendicitis	540-543	540-543	0-64
Intestinal obstruction and hernia	550-553, 560	550-553, 560	0-64
Cholelithiasis and cholecystitis	574-575	574-575.1, 576.1	0-64
Complications of pregnancy, childbirth, and the puerperium	630-678	630-678	0-74
Perinatal mortality	760-779	760-799	--

Table A.3: Mackenbach 1988

Cause	ICD8 Code	ICD9 Code	Age Group
Specific medical therapies (1922, 1927, 1945)			
Diseases of the thyroid	240-246	240-246	0-74
Diabetes mellitus	250	250	<25
Pernicious anemia	281	281	0-74
Other anemia	280, 282-285	280, 282-285	0-74
Improvements in surgery/ anaesthesia (ca 1930)			
Peptic ulcer	531-534	531-534	0-74
Appendicitis	540-543	540-543	0-74
Cholelithiasis/-cystitis	574-576	574-576	0-74
Abdominal hernia	550-553	550-553	0-74
Ilieus without hernia	560	560	0-74
Benign prostatic hyperplasia	600	600	0-74
Improvements in antenatal and perinatal care (ca 1930)			
Maternal causes:			
Complications of pregnancy	630-639	630-633,640-648	0-74
Complications of delivery	640-645,650-662	634-639,650-669	0-74
Complications of puerperium	670-678	670-676	0-74
Perinatal causes:			--
Diseases of mother	760-763	760	0-74
Birth injury	764-768,770-772	762, 763,767	0-74
Hemolytic disease of newborn	774,775	773,774	0-74
Other perinatal causes	769, 773, 776-779	761, 764-766, 768-772, 775-779	0-74
Chemotherapeutics (1936) and antibiotics (ca 1930)			
Tuberculosis	010-019	010-018, 137	0-74
Pneumonia/ influenza	470-474, 480-486	480-486, 487	0-74
Septicemia	038	038, 790.7,771.8*	0-74
Infections of the urinary system	590,595	590,595	0-74
Other infectious diseases:	098,099,034-036	092,099,034-036	0-74
Specific bacterial infections	052,055,056,057,072	052,055,056,057,072	
Viral infections of children	090-097	090-097	
Syphilis	045,046,064-066, 320-	046-049, 139.0, 320-326	
Infections of the central nervous system, respiratory system, skin, locomotor system	324, 380-384, 460-466, 680-686, 710, 720	380-385, 460-466, 680-686, 711, 730	
Surgical repair of congenital anomalies (ca 1950)			
Congenital digestive anomalies	750-751	750-751	0-74
Congenital cardiovascular anomalies	746-747	745-747	0-74
Prophylaxis (ca 1950) and heart valve surgery (ca 1965)			
Rheumatic heart disease	390-398, 424	393-398,424	0-74
Mass vaccination (1953)			0-74
Diphtheria/whooping cough/tetanus/poliomyelitis	032,033,037,040-044	032,033,037,045,138	0-74
Haemodialysis (ca 1960)			
Nephritis and nephrosis	580-584,593, 792	580-589, 593	0-74
Hypertension detection and treatment (ca 1960)			
Hypertensive disease	400-404	401-405	0-74
Cerebrovascular disease	430-438	430-438	0-74
Improvements in cancer treatment [a.o. combination chemotherapy (ca 1970)]			
Cancer of lip and skin	140, 173	140, 173	0-74
Cancer of kidney	189	189	<15
Morbus Hodgkin	201	201	0-74
Cancer of the testis	186	186	0-74
Leukemia	204-207	204-208	<15
Mass screening (1976)			
Cancer of cervix uteri	180	180	0-74

* Deaths were included as 'other perinatal causes' and not 'septicemia'

Table A.4: Holland 1988

Cause	ICD8 Code	ICD9 Code	Age Group
Medical care indicators			
Tuberculosis	010-019	010-018, 137	5-64
Cancer of the uterus body (except cervix uteri)	182	179, 182	15-64
Cancer of the cervix uteri	180	180	15-64
Hodgkin's disease	201	201	5-64
Chronic rheumatic heart disease	393-398	393-398	5-44
Respiratory diseases (except asthma)	460-492, 500-519	460-492, 494-519	1-14
Asthma	493	493	5-44
Appendicitis	540-543	540-543	5-64
Abdominal hernia	550-553	550-553	5-64
Cholelithiasis and cholecystitis	574-575	574-575.1, 576.1	5-64
Hypertension and cerebrovascular disease	400-404, 430-438	401-405, 430-438	35-64
Typhoid	001	002	5-64
Whooping cough	033	033	0-14
Tetanus	037	037	0-64
Measles	055	055	0-64
Osteomyelitis	720	730	1-64
Maternal deaths	630-678	630-676	0-74
Perinatal deaths	760-779	760-799	--
National health policy indicators			
Malignant neoplasm of trachea bronchus and lung	162	162	5-64
Cirrhosis of the liver	571	571	15-64
Motor vehicle accidents	E810-E823	E810-E825	0-74

Table A.5: Holland 1997

Cause	ICD8 Code	ICD9 Code	Age Group
Tuberculosis	010-019	010-018, 137	5-64
Malignant neoplasm of uterus body (except cervix uteri)	182	179, 182	15-54
Malignant neoplasm of the cervix uteri	180	180	15-64
Malignant neoplasm of the breast	174	174	25-64
Hodgkin's disease	201	201	5-64
Chronic rheumatic heart disease	393-398	393-398	5-44
All respiratory diseases (except Asthma)	460-492, 500-519	460-492, 494-519	1-14
Asthma	493	493	5-44
Peptic ulcers	531-534	531-534	25-64
Appendicitis	540-543	540-543	5-64
Abdominal hernia	550-553	550-553	5-64
Cholelithiasis and cholecystitis	574-575	574-575.1, 576.1	5-64
Ischaemic heart disease	410-414	410-414, 429.2	35-64
Hypertension and cerebrovascular disease	400-404, 430-438	401-405, 430-438	35-64
Maternal deaths	630-678	630-676	0-74
Perinatal deaths	760-779	760-799	--

Table A.6: Humblet 2000

Cause	ICD8 Code	ICD9 Code	Age Group
Curative indicators			
Tuberculosis	010-019	010-018, 137	1-64
Malignant neoplasm of the breast	174	174	1-64
Malignant neoplasm of the cervix/ uterus body	180, 182	179-180, 182	1-64
Malignant neoplasm of the testis	186	186	1-64
Hodgkin's disease	201	201	1-64
Hypertension and cerebrovascular disease	400-404, 430-438	401-405, 430-438	1-64
Chronic rheumatic heart disease	393-398	393-398	1-64
Asthma	493	493	1-64
Peptic ulcers	531-534	531-534	1-64
Appendicitis	540-543	540-543	1-64
Abdominal hernia	550-553	550-553	1-64
Cholelithiasis and cholecystitis	574-575	574-575.1, 576.1	1-64
Maternal deaths	630-678	630-676	1-64
Preventive indicators			
Malignant neoplasms of the trachea, bronchus and lung	162	162	1-64
Malignant neoplasms of the skin (non melanoma)	173	173	1-64
Ishaemic heart disease	410-414	410-414, 429.2	1-64
Cirrhosis of the liver	571	571	1-64
Motor vehicle accidents	E810-E823	E810-E825	1-64

Table A.7: Nolte 2002

Cause	ICD8 Code	ICD9 Code	Age Group
Causes responsive to medical care			
Intestinal infections	001-009	001-009	0-14
Tuberculosis	010-019	010-018, 137	0-74
Other infections:			0-74
Diphtheria	032	032	
Tetanus	037	037	
Poliomyelitis	040-044	045	
Osteomyelitis and periostits	720	730	
Whooping cough	033	033	0-14
Septicaemia	038	038	0-74
Measles	055	055	1-14
Malignant neoplasm of the skin	173	173	0-74
Malignant neoplasm of the breast	174	174	0-74
Malignant neoplasm of the cervix uteri	180	180	0-74
Malignant neoplasm of the testis	186	186	0-74
Hodgkin's disease	201	201	0-74
Leukaemia	204-207	204-208	<15
Diseases of the thyroid	240-246	240-246	0-74
Diabetes mellitus	250	250	0-49
Rheumatic heart disease	393-398	393-398	0-74
Hypertensive disease	400-404	401-405	0-74
Cerebrovascular disease	430-438	430-438	0-74
All Respiratory diseases (except pneumonia/ influenza)	460-466, 490-519	460-479, 488-519	1-14
Pneumonia/ influenza	470-474, 480-486	480-487	0-74
Peptic ulcer	531-534	531-534	0-74
Appendicitis	540-543	540-543	0-74
Abdominal hernia	550-553	550-553	0-74
Cholelithiasis, cholecystitis, and cholangitis	574-575	574-575.1, 576.1	0-74
Nephritis and nephrosis	580-584	580-589	0-74
Benign prostatic hyperplasia	600	600	0-74
Maternal deaths	630-678	630-676	0-74
Congenital cardiovascular anomalies	746-747	745-747	0-74
Perinatal deaths, all causes excluding stillbirths	760-779	760-779	0-74
Ischaemic heart disease	410-414	410-414, 429.2	0-74
Causes responsive to health policy			
Malignant neoplasm of the trachea, bronchus and lung	162	162	0-74
Cirrhosis of liver	571	571	0-74
Motor vehicle accidents	E810-E823	E810-E825	0-74

Table A.8: Master list of 'avoidable' deaths†

Cause	ICD8 Code	ICD9 Code	Age Groups
Ischaemic heart disease	410-414	410-414, 429.2	35-74
Deaths amenable to medical intervention			
Intestinal infections*	000-009	001-009	0-14
Tuberculosis*	010-019	010-018, 137	0-74
Diptheria*	032	032	0-74
Whooping cough*	033	033	0-14
Tetanus*	037	037	0-74
Septicaemia	038	038	0-74
Poliomyelitis*	040-044	045	0-74
Measles*	055	055	1-14
Syphilis*	090-097	090-097	0-74
Other bacterial infections	020-031, 034, 320, 381-383,390-392,680-686,710	019-031, 034, 320-322, 381-383, 390-392, 680-686, 711	0-74
Malignant neoplasm of the skin (non melanoma)* [Skin cancer]	173	173	0-74
Malignant neoplasm of the female breast [Female breast cancer]	174	174	25-74
Malignant neoplasm of the cervix uteri* [Cervical cancer]	180	180	15-74
Malignant neoplasm of the uterus (except cervix uteri) [Uterine cancer]	182	179, 182	15-74
Malignant neoplasm of the testis [Testicular cancer]	186	186	0-74
Hodgkin's disease	201	201	0-74
Leukaemia	204-207	204-208	0-14
Diseases of the thyroid*	240-246	240-246	0-74
Diabetes mellitus	250	250	0-49
Deficiency anaemias*	280-281	280-281	0-74
Epilepsy	345	345	0-74
Active rheumatic fever*	390-392	390-392	0-74
Chronic rheumatic heart disease	393-398	393-398	0-74
Hypertensive disease	400-404	401-405	35-74
Cerebrovascular disease	430-438	430-438	35-74
Acute respiratory infections (except influenza)*	460-466	460-466	1-14
Influenza*	470-474	487	0-74
Pneumonia*	480-486	480-483, 485-486	0-74
Bronchitis*	490	490	0-74
Emphysema*	492	492	0-74
Asthma*	493	493	0-49
Gastric and duodenal ulcer [Peptic ulcer]	531-534	531-534	0-74

†From Charlton 1983, Poikolainen 1986, Mackenbach 1988, Holland 1988, Holland 1997, Humblet 2000 and Nolte 2002
*Sentinel causes of death according to Rutstein et al.
Note: Simplified names for some of the causes are presented within square brackets.

Table A.8: Master list of 'avoidable' deaths† *(continued)*

Cause	ICD8 Code	ICD9 Code	Age Group
Appendicitis*	540-543	540-543	0-74
Abdominal hernia*	550-553	550-553	0-74
Ilieus without hernia	560	560	0-74
Cholelithiasis, cholecystitis, and cholangitis	574-575	574-575.1, 576.1	0-74
Nephritis and nephrosis	580-584	580-589	0-74
Infections of the urinary system	590,595	590,595	0-74
Hyperplasia of prostate	600	600	0-74
Complications of pregnancy* [Maternal mortality]	630-678	630-676	0-74
Osteomyelitis and periostitis	720	730	0-74
Congenital cardiovascular anomalies	746-747	745-747	0-74
Congenital digestive anomalies	750-751	750-751	0-74
Perinatal conditions*	760-779	760-779	--
Deaths amenable to public health			
Malignant neoplasm of the trachea, bronchus and lung* [Lung cancer]	162	162	0-74
Cirrhosis of the liver	571	571	0-74
Motor vehicle accidents	E810-823	E810-825	0-74

†From Charlton 1983, Poikolainen 1986, Mackenbach 1988, Holland 1988, Holland 1997, Humblet 2000 and Nolte 2002
*Sentinel causes of death according to Rutstein et al.
Note: Simplified names for some of the causes are presented within square brackets.

Appendix B Comparing Calculation Tools

Two indicators of mortality were considered: death rates and years of life lost. For calculations of years of life lost, two computation methods were applied: period expected years of life lost (EYLL) and potential years of life lost (PYLL). Crude as well as age-standardized years of life lost rates were calculated. When comparing mortality across quintiles, the richest neighbourhood income quintile (Q1) was compared to both the poorest quintile (Q5) and the total population (QT). Finally, mortality disparities across groups were presented using rate differences (RDs) and rate ratios (RRs). The purpose of this chapter is to describe and compare the nature of these tools and to justify why this study focussed on certain calculations.

Population Distributions: Standardizing Mortality Rates

For each of the years considered, the population age distributions of each quintile were dissimilar. The quintile age distributions during 1971 and 1996 are displayed in Figure B.1.

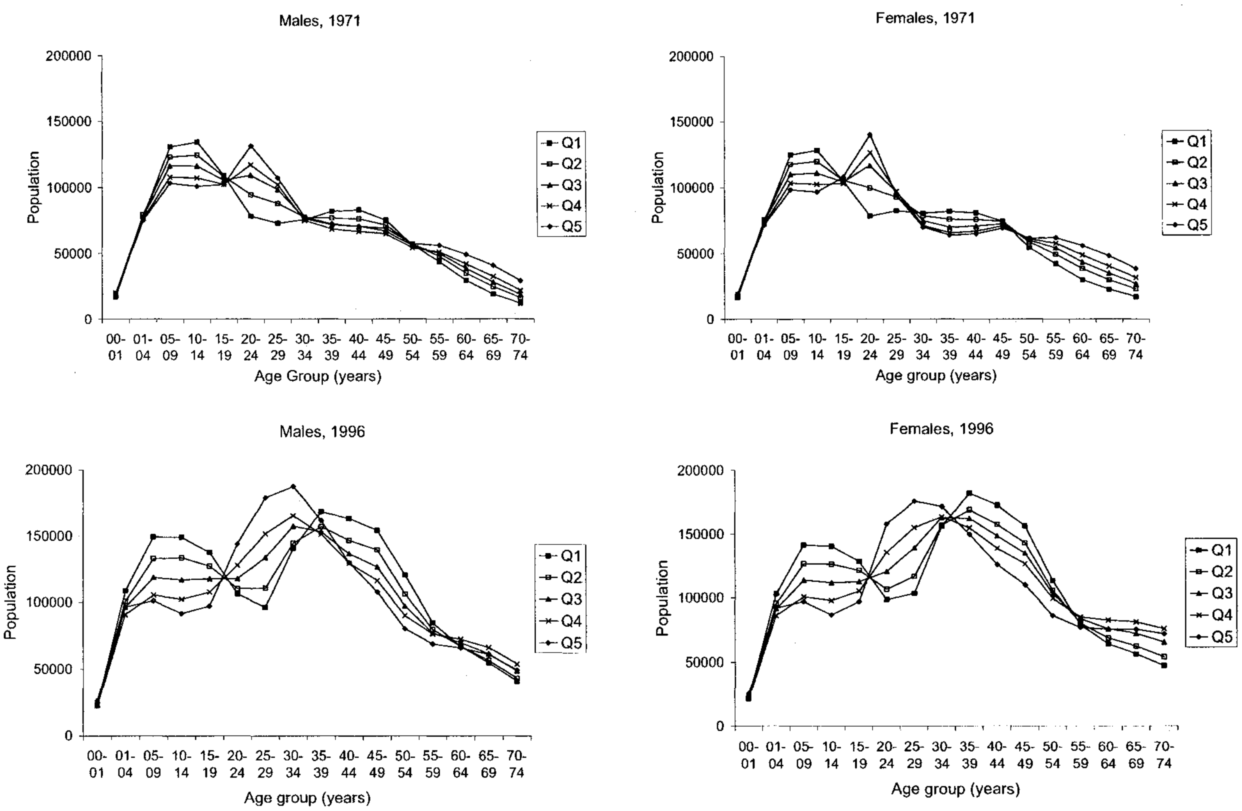

Figure B.1: Population age distributions to age 74 years, by neighbourhood income quintile, males and females, urban Canada, 1971 to 1996
Abbreviations: Q1: poorest quintile, Q5: richest quintile

For both sexes, quintile populations were similar between the ages of 0-4, 15-24, 30-39, and 50-65. However, the quintile population age distributions diverge for the other age groups. The population sizes follow a quintile gradient trend. For example, for the age group 20-24, Q5 had the largest population, followed by Q4, Q3, Q2, and the smallest population was that of Q1. Conversely, for the age group 10-14, the Q1 had the largest population, followed by Q2, then Q3, Q4, and the smallest population was that of Q5. The differences between quintile age group populations increased from 1971 to 1996.

To eliminate the influence of the different quintile population age structures, the results are presented using age-standardized mortality rates.

Mortality Indicators: Death Counts and Years of Life Lost

The indicator most commonly used to examine mortality inequalities is the death rate. However, in Canada, death rates are dominated by deaths that occur in the elderly and it has been argued that deaths at earlier ages result in a greater loss of human potential and productivity.[8,12,60,155,267] "Years of life lost" (YLL) has previously been used as a premature mortality indicator that takes into account the age at death as well as the fact of death itself.[8,155] YLL is defined as the number of years persons would have lived had had they experienced normal life expectations or a fixed upper age limit.[154] Since the Lalonde report,[268] YLL has been used to examine the relative importance of different causes of death and to develop priorities for preventing premature deaths in Canada.[98,201,269] YLL have only recently been used to describe mortality disparities.[8,12,270] In Canada, Wilkins et al.[30,31] calculated the proportion of potential years of life lost (PYLL) prior to age 75 that could be attributed to neighbourhood income differences and they presented the major causes of death that contributed the greatest to income-related excess PYLL.

For YLL calculations, the choice of upper age limit for calculating age specific remaining years of life varies between 65 and 80, however some studies have also applied age-specific life expectancies to calculate years of life lost.[155,245] This section outlines some differences between death counts, period expected years of life lost (EYLL) and potential years of life lost (PYLL) mortality indicators as they relate to calculating rate differences (RDs) and rate ratios (RRs). First, some properties of death counts, EYLL and PYLL mortality indicators will be described. Second, all cause ASMR, SEYLL, and SPYLL, and RD and RR trends will be compared.

Properties of age group death rates, EYLL and PYLL

Table B.1 presents the age group-specific years of life lost derived for males in 1996 when applying ASMR, EYLL and PYLL. Figure B.2 displays the age group PYLL and EYLL per death in each age group.

Table B.1: Age group years of life lost (age range 0 to 74 years) per death, by mortality indicator, by age group, males, urban Canada, 1996

	Death Counts		EYLL		PYLL	
Age Group	YLL	P*	YLL	P	YLL	P
<1	1	0.063	75.99	0.110	74.9	0.117
01-04	1	0.063	73.52	0.106	73	0.114
05-09	1	0.063	69.08	0.100	67.5	0.106
10-14	1	0.063	64.13	0.093	62.5	0.098
15-19	1	0.063	59.24	0.086	57.5	0.090
20-24	1	0.063	54.43	0.079	52.5	0.082
25-29	1	0.063	49.66	0.072	47.5	0.074
30-34	1	0.063	44.91	0.065	42.5	0.067
35-39	1	0.063	40.21	0.058	37.5	0.059
40-44	1	0.063	35.56	0.051	32.5	0.051
45-49	1	0.063	30.98	0.045	27.5	0.043
50-54	1	0.063	26.52	0.038	22.5	0.035
55-59	1	0.063	22.28	0.032	17.5	0.027
60-64	1	0.063	18.31	0.026	12.5	0.020
65-69	1	0.063	14.72	0.021	7.5	0.012
70-74	1	0.063	11.56	0.017	2.5	0.004
00-74	16	1.000	691.1	1.000	637.9	1.000

Abbreviations: EYLL: period expected years of life lost,
PYLL: potential years of life lost,
YLL: years of life lost
*Proportion of total years of life lost up to 74 years of age attributed to each age group

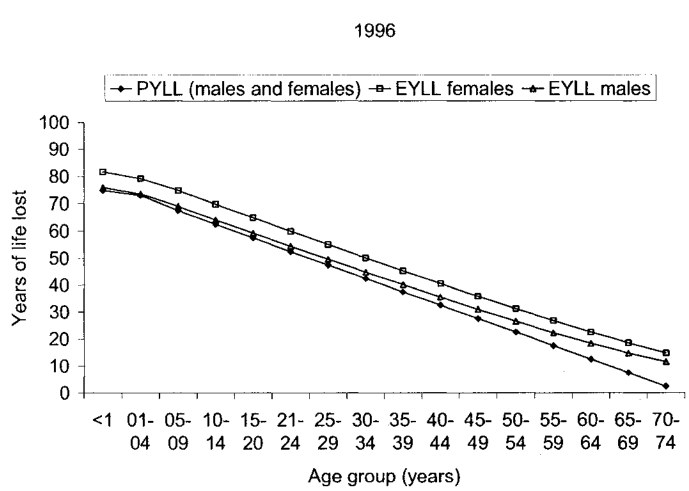

Figure B.2: Age group PYLL and EYLL per death, males and females, urban Canada, 1996
Abbreviations: PYLL: potential years of life lost,
EYLL: period expected years of life lost

Death counts weigh deaths at all ages equally. Therefore, ages where deaths are predominant will have the greatest influence on the total mortality rate. EYLL are based on the number of years a person of age 'x' from the richest neighbourhood income quintile could expect to live, according to 1996 period life tables developed by Wilkins et al.[31] PYLL were calculated by subtracting the mid-age of each age group from 75.

As expected, EYLL are greater than PYLL for all age groups. This difference increased for deaths in older age groups. This implies that the burden of mortality from conditions that occur in older ages, such as deaths from chronic conditions, is given more value when considering EYLL compared to PYLL. For example, the PYLL method assumes that only 2.5 years of life are lost for deaths of persons aged 70 to 74 years. In 1996, however, the remaining life expectancy of males and females in Q1 were 11.56 and 14.72 years, respectively. This is a meaningful difference between EYLL and PYLL: while both methods add value to deaths a younger ages compared to death counts, PYLL practically ignores deaths at older ages while EYLL considers deaths are older ages as a burden to society.[245]

Comparing SEYLL, SPYLL and ASMR Rate Ratios and Rate Differences

All cause quintile ASMR, SEYLL and SPYLL, and rate differences (RDs) and rate ratios (RRs) from 1971 to 1996 are presented in Table B.2.

Table B.2: All cause mortality (age range 0 to 74 years) rate difference and rate ratio per 100,000 population, by mortality indicator, Q5-Q1 and QT-Q1, by sex, urban Canada, 1971 to 1996

YEAR	SEYLL				SPYLL				ASMR			
	Q5-Q1		QT-Q1		Q5-Q1		QT-Q1		Q5-Q1		QT-Q1	
	RR	RD	RR	RD	RR	RD	RR	RD	RR	RD	RR	RD
Males												
1971	1.71	9,240	1.31	3,977	1.76	7,050	1.33	3,028	1.63	342	1.27	145
1986	1.85	7,705	1.33	3,020	1.91	5,754	1.35	2,200	1.77	301	1.31	123
1991	1.93	7,297	1.34	2,688	1.98	5,437	1.35	1,909	1.85	286	1.34	114
1996	1.88	6,378	1.33	2,384	1.97	4,860	1.35	1,781	1.76	241	1.29	93
Females												
1971	1.51	4,302	1.22	1,888	1.61	3,291	1.26	1,428	1.37	112	1.17	50
1986	1.46	2,861	1.17	1,038	1.50	1,974	1.18	691	1.40	92	1.15	36
1991	1.51	2,778	1.19	998	1.57	1,903	1.20	656	1.45	91	1.17	35
1996	1.53	2,680	1.20	1,030	1.60	1,859	1.23	707	1.45	86	1.18	34

Abbreviations: SEYLL: age-standardized period expected years of life lost,
SPYLL: age-standardized potential years of life lost,
ASMR: age-standardized mortality rate,
Q5-Q1: poorest quintile-richest quintile comparison,
QT-Q1: total population-richest quintile comparison,
RR: rate ratio, RD: rate difference

SEYLL RDs are greater than SPYLL RDs. This is due to the additional years of life lost calculated when considering EYLL compared to PYLL for the same mortality rates. For example, for each death contributing to the difference between the richest quintile and the poorest quintile, there will be more EYLL difference than PYLL difference.

ASMR RRs are lower than SEYLL RRs, which are lower than SPYLL RRs. This is because YLL measures put greater value on deaths at younger ages compared to death counts, and PYLL places more value on premature deaths than EYLL (Table B.1 and Figure B.2). If all these mortality measures valued deaths within the same age group equally, then their RRs would be the same. Quintile relative mortality disparity is greater when more emphasis is placed on deaths at younger ages.

The mortality trends are presented using years of life lost in order to place added value to deaths that occur at younger ages. EYLL trends are shown because this measure puts a more meaningful value to deaths that occur later in life compared to PYLL.

Socioeconomic Effects and Impact on Mortality: Q5-Q1 Versus QT-Q1

The purpose of this section is to outline what the poorest quintile-richest quintile (Q5-Q1) and total population-richest quintile (QT-Q1) comparisons indicate and to describe the relationship between Q5-Q1 and QT-Q1 disparity time-trends using all cause mortality as an example.

Interpreting QT-Q1 and Q5-Q1 Comparisons

While Q5-Q1 comparisons examine the effect of socioeconomic differences between the richest and poorest quintiles, QT-Q1 comparisons examine the "total impact" of socioeconomic status across the entire population (all quintiles).[29,158] QT-Q1 comparisons are similar to the Population-Attributable Risk (PAR) measures described by Mackenbach and Kunst,[158] in that these measures reflect both the socioeconomic groups' mortality rates and their relative population size. QT-Q1 RDs and RRs can be interpreted as the absolute and relative reduction in mortality that would occur if the entire population experienced the mortality level of the richest quintile; however it must be noted that this assumes that the mortality inequality in a population can be reduced my lowering the mortality burden of the poorer quintiles to the level experienced by the richest quintile.[158]

QT-Q1 and Q5-Q1 Disparity Trends

The temporal trends for QT-Q1 and Q5-Q1 comparisons were comparable, even though QT-Q1 and Q5-Q1 measure different aspects of mortality disparity. This is because QT mortality incorporates the mortality experiences of all quintiles including Q5, which experienced the highest proportion of the populations' "excess" mortality. For example, Figure B.3 displays the all cause SEYLL rates, by neighbourhood income quintile, for males and females from 1971 to 1996.

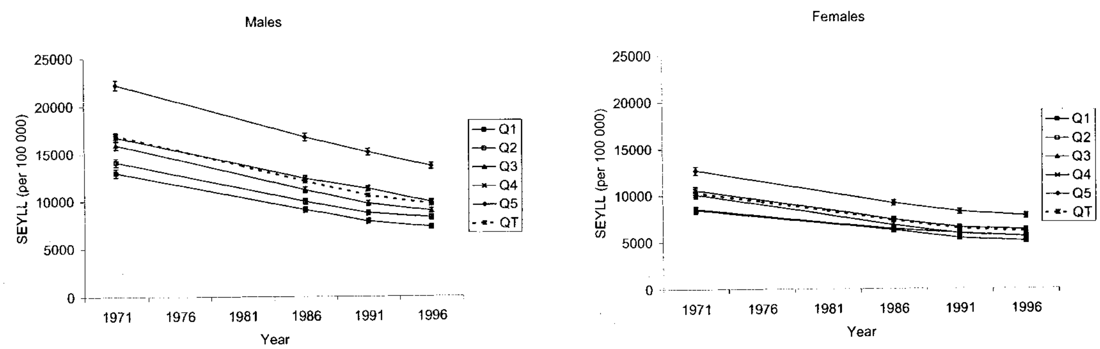

Figure B.3: All cause (age range 0 to 74 years) SEYLL rate, by neighbourhood income quintile, males and females, urban Canada, 1971 to 1996
Abbreviations: SEYLL: age-standardized period expected years of life lost, Q1: richest quintile, Q5: poorest quintile, QT: total population (all quintiles)

The SEYLL rate for Q5 was remarkably greater than the other quintiles for both sexes in all of the years considered. Table B.3 presents the all cause Q5-Q1 and QT-Q1 SEYLL RRs and RDs from 1971 to 1996.

Table B.3: All cause (age range 0 to 74 years) SEYLL rate ratio and rate difference per 100,000 population, Q5-Q1 and QT-Q1, by sex, 1971 to 1996

YEAR	Q5-Q1		QT-Q1	
	RR	RD	RR	RD
Males				
1971	1.71	9,240	1.31	3,977
1986	1.85	7,705	1.33	3,020
1991	1.93	7,297	1.34	2,688
1996	1.88	6,378	1.33	2,384
Females				
1971	1.51	4,302	1.22	1,888
1986	1.46	2,861	1.17	1,038
1991	1.51	2,778	1.19	998
1996	1.53	2,680	1.20	1,030

Abbreviations:

Q5-Q1: poorest quintile-richest quintile comparison,
QT-Q1: total population-richest quintile comparison,
RR: rate ratio, RD: rate difference,

RRs and RDs were larger for the Q5-Q1 comparisons compared to the QT-Q1 comparisons, indicating that the disparity between Q1 and Q2, Q3, and Q4 was considerably less than the disparity between Q1 and Q5. However, the QT-Q1 and Q5-Q1 trends were comparable. The quintile population sizes were very similar (Table 3.2) and therefore QT-Q1 mortality disparities were principally influenced by the quintile mortality rates. Since Q5 had substantially greater SEYLL rates compared to the other quintiles, the QT-Q1 RR and RD trends were strongly influenced by the Q5-Q1 trends. This study focused on Q5-Q1 avoidable mortality difference trends in order to highlight the disparites between the richest and poorest quintiles. However, the cause-specific contributions to QT-Q1 avoidable mortality disparity will be shown to focus on the total impact of these causes on mortality inequality. When describing cause-specific mortality disparity trends, the Q5-Q1 and QT-Q1 comparisons are presented.

Comparing Summary Statistics: Rate Difference Versus Rate Ratio

Several summary indices are available to express the magnitude of mortality differences between socioeconomic groups. There is no single measure that is clearly superior to all other measures since different measures capture different perspectives on socioeconomic differences in mortality.[16,158,271] For this study, absolute disparity between quintile populations was determined by computing rate differences (RDs). To determine the relative disparity, rate ratios (RRs) were calculated. Trends in RDs and RRs may yield different patterns that may contradict each other, since different mathematical models define these measures. The rate difference is defined by the additive model and can be expressed as:

$$RD_i = I_{i1} - I_{i0} \qquad (1)$$

where I_{i1} is the incidence of an event in the exposed populations for the i-th stratum and I_{i0} is the incidence of the event in the unexposed (or reference) populations in the i-th stratum (also known as the baseline rate).

The rate ratio is defined by the multiplicative model and can be expressed as:

$$RR_i = I_{i1} / I_{i0} \qquad (2)$$

To illustrate the relation between these two measures, from equation (1) we can substitute for I_{i1} in equation (2) to express the rate ratio as:

$$RR_i = (I_{i0} + RD_i) / I_{i0} \qquad (3)$$

Which, reduces to:

$$RR_i = 1 + RD_i/I_{i0} \qquad (4)$$

Therefore, the rate ratio is a function of the rate differences and the incidence rate in the reference population.[159] An example is provided below by presenting the differences in years of life lost RRs and RDs for ischaemic heart disease in males. Figure B.4 displays SEYLL rate trends from ischaemic heart disease, by neighbourhood income quintile, for males from 1971 to 1996.

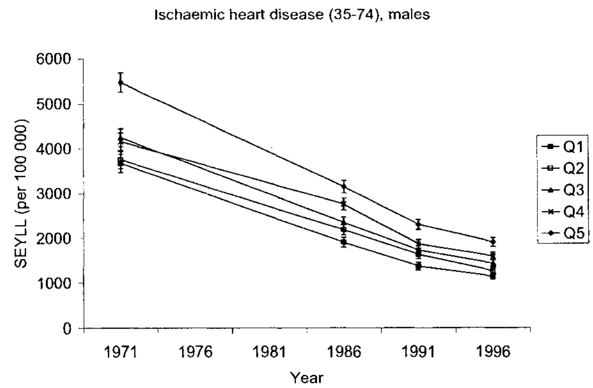

Figure B.4: Ischaemic heart disease (age range 35 to 74 years) SEYLL by neighbourhood income quintile, males, urban Canada, 1971 to 1996
Abbreviations: SEYLL: age-standardized period expected years of life lost, Q1: richest quintile, Q5: poorest quintile, QT: total population (all quintiles)
Note: Bars represent 95% confidence intervals

Mortality from ischaemic heart disease decreased in all quintiles form 1971 to 1996. Also, the difference in mortality between the richest and poorest quintiles has decreased from 1971 to 1996. Table B.4 presents the quintile RRs and RD from for ischaemic heart disease from 1971 to 1996.

Table B.4: Ischaemic heart disease (age range 35 to 74 years) SEYLL rate ratio and rate difference per 100,000 population, Q5-Q1 and QT-Q1, males, urban Canada, 1971 to 1996

		Q5-Q1				QT-Q1		
Year	n*	RR	95%CI	RD	95%CI	RR†	RD	95%CI
1971	9,573	1.49	(1.38, 1.60)	1,800.19	(1,507.77, 2,092.61)	1.20	724.32	(241.14, 1,207.50)
1986	8,488	1.65	(1.52, 1.80)	1,241.25	(1,061.47, 1,421.04)	1.32	601.79	(348.82, 854.76)
1991	6,985	1.68	(1.54, 1.85)	939.07	(795.30, 1,082.84)	1.30	414.22	(219.90, 608.55)
1996	6,609	1.66	(1.51, 1.83)	762.31	(640.34, 884.28)	1.29	337.03	(185.58, 488.49)

Abbreviations: RR: rate ratio, RD: rate difference, 95%CI: 95% confidence interval
*Number of deaths
†Confidence interval for QT-Q1 RR not available

Inspection of the QT-Q1 and Q5-Q1 RRs reveals that there was a significant association between neighbourhood income quintile and SEYLL from ischaemic heart disease and that this association increased from 1971 to 1991. QT-Q1 and Q5-Q1 SEYLL RDs indicate that the absolute disparity decreased in both sexes from 1971 to 1996. Therefore, in general, the relative disparity increased while the absolute disparity decreased from 1971 to 1996. These contradicting trends occur because while QT-Q1 and Q5-Q1 SEYLL RDs were decreasing, so was the SEYLL baseline rate (the SEYLL rate of Q1) (Figure B.4). Therefore, although the gap between the rich and poor quintiles was diminishing, the absolute gains in SEYLL disparity were not captured by the RR trends.

Because the magnitude of the relative effect depends on the baseline rate, the same absolute effect between time periods may correspond to very different relative effects and vice versa. Furthermore, RDs and RRs provide different kinds of information. RRs measure the strength of association between an exposure and an outcome. In contrast, RDs provide insight into the public health impact of an exposure, assuming the associations involved are causal.[60,272]

Since the purpose of this study is to examine temporal changes in avoidable mortality disparity, this study will focus on time-trends in the quintile avoidable mortality RDs.

Appendix C Limitations of Mortality Data

There are important limitations that should be considered when conducting epidemiological studies using mortality data. The purpose of this section is to outline some of these limitations and discuss their implications for this study. First, problems with certifying and coding causes of death will be identified. Second, difficulties when using the underlying cause of death will be mentioned. Third, the influence of competing causes of death will be presented. Finally, the implications of these limitations will be discussed.

Certifying Cause of Death

Assigning the conditions leading to the death of a person is the responsibility of the attending physician. In cases where a death is deemed 'unnatural' or the attending physician is not in attendance when the death occurred, the physician cannot complete the death certificate and must instead report the death to a coroner. The coroner is trained to investigate clinical information and autopsy results to determine cause of death.[236,273]

Inaccuracies in cause of death certification can occur at various stages in the certification process. The amount of information regarding the decedent's cause of death is dependent on the extent to which the person was studied medically prior to death, the sophistication of the diagnostic procedures used to investigate the disease processes at death, the familiarity the attending physician had with the decedent; and on whether an autopsy was done.[236,273-275] Physicians may feel compelled to promptly complete death registrations in order to facilitate funeral arrangements. In many circumstances, the physician completing in the medical certificate of death may not be the physician who knows the most about the case.[273,274]

Generally, physicians do not receive enough training to accurately ascribe causes of death.[236,273,276,277] When assessing the knowledge, attitudes and behaviours of general practitioners in relation to death certification, Maudley and William[273] discovered that 80% of the practitioners who identified a need for death certification improvement felt that they did not have enough information readily available for completing the death certificate and 53% felt that they required more training in death certification. In an audit of death certificates completed by residents of a Canadian teaching hospital in 1995, Myers and Farquhar[236] observed that 33% of the certificates contained at least one major error. Following an educational intervention (death certification seminars for residents), the major error rate decreased to 16%.

For some causes of death (such as suicide), the stigma attached to the condition may influence the certifying doctor to not mention the cause of death in order to spare the deceased's relatives' distress.[273,278] Maudley and William[273] observed that 17% of the general practitioners they surveyed would modify the true 'cause of death' statement on a death certificate in order to avoid distressing the deceased's relatives.

Diagnostic labelling trends are possible, in that certain causes may be more common in some settings relative to others.[279,280] For example, an international comparison of cause of death certifying practices in the European Community revealed substantial discrepancies in the cause of death certification for cancers of the uterus and cervix uteri.[280]

Coding Cause of Death

The information on death registrations is converted to codes to produce data records. Until recently, the only cause of death that has been coded in Canada was the underlying cause of death.[212] In Canada, cause of death diagnostic codes follow internationally accepted WHO International Classification of Diseases (ICD) conventions. For the purpose of this study, ICD-8 codes were used for deaths that occurred in 1971 and ICD-9 codes for deaths that occurred in 1986, 1991, and 1996. In circumstances where the death certificate was completed incorrectly, the underlying cause of death is selected using ICD decision rules.[281]

Currently in Nova Scotia, New Brunswick, Quebec, Ontario, Saskatchewan, Alberta and British Columbia, death certificate information is coded by provincial nosologists trained by a member of the Nosology Department of the Health Division at Statistics Canada. For Newfoundland, Prince Edward Island, and the Territories, death certificate information is coded at Statistics Canada.[282]

In general, it is assumed that cause of death coding is reliable since it is based on ICD standardized coding rules.[283] However, nosologists may modify the order of causes noted on the certificate based on their interpretation of ICD rules.[283-286] Lu et al.[284] observed that the nosologists' acceptance or rejection of the certifier's statement of causation and their interpretation of ICD rules were important sources of disagreement. One contributing factor to this problem was a lack of information in the ICD manuals about the application of coding rules.[284] Lu et al.,[284] however, also found that the coding practices for certain conditions, such as malignant neoplasms and injuries, tended to be accurate. For conditions where disagreements between nosologists existed, the net effect on the cause-specific mortality trends was not significant. They attributed this to the "compensatory effect of errors", where conditions that are undercoded in some situations are overcoded in others. Since 1989, most jurisdictions in Canada use automated mortality-coding software in order to promote consistency in cause of death selection. Furthermore, Statistics Canada and provincial vital statistics offices conduct data quality assurance tests regularly. This has been done in an effort to eliminate bias and identify potential sources of error. Data errors or omissions that have been detected are investigated and, if possible, corrected.[282]

ICD rules change periodically, either in the description of ICD nomenclature or revisions of the ICD codes.[275,287,288] These changes can de-emphasize certain causes of death while over-reporting others. For this study, differences in ICD8 and ICD9 coding may introduce variation in the mortality data. However, the ICD8 and ICD9 codes for most of the conditions selected have not changed. Charlton and Valez[77] and Albert et al.[113] observed no difference in their 'avoidable' mortality trends as a result of ICD coding changes.

Underlying Cause of Death

Conventionally, mortality statistics identify a single, underlying cause of death.[123,278,279] Recently, other causes that contributed to the underlying death have been included in Canadian mortality databases.[212] Despite this database expansion, the majority of studies on cause of death (including this study) continue to apply the underlying cause of death. Due to the lengthening life expectancies in many countries, including Canada, people are more likely to die with multiple conditions, each contributing to their risk of death.[212,289,290] Therefore, the assignment of one underlying cause may not adequately indicate the disease processes present at death. Also, some conditions are more likely to be considered an underlying cause of death than others.[153,212,289,290]

Goldacre[153] analyzed hospital records linked to death registrations from the Oxford region in order to determine the extent to which each main hospital diagnoses made four weeks and diagnoses made one year prior to death were recorded on the patients' death certificates. Goldacre[153] categorized causes of death based on three broad patterns of certification. First, there were conditions that were usually diagnosed by the hospital and mentioned on the death certificate as the underlying cause of death. These causes included lung cancer, breast cancer, cervical cancer, leukemia lymphoma, myocardial infarction, cerebrovascular disease, and pneumonia. Second, there were conditions that were diagnosed in the hospital and mentioned on the death certificate, but not as the underlying cause of death. These causes included diseases of the thyroid, diabetes mellitus, and tuberculosis. Third, there were conditions that were diagnosed by the hospital, but were not present on the death certificate. These conditions included hypertension, asthma, and anaemia.[153] Recently, Johansson and Westerling[237] compared hospital discharge diagnoses with death certificates in Sweden and categorized causes of death comparably to Goldacre.[153]

These results indicate some avoidable disease patterns among people who die may not be recognized using mortality data, especially when considering the underlying cause of death. On the other hand, there are good reasons for accurate certified causes of death to be dissimilar to hospital diagnoses. For instance, in cases where the hospital diagnosis is a complication of the underlying cause, the diagnosis would be correctly considered secondary to the underlying cause of death. However, later work by Johansson and Westerling[238] revealed that in over one third of cases in which the underlying cause of death was different from the hospital discharge diagnosis, the differences could not be explained by ICD selection rules because the conditions were medically incompatible.

In order to understand the extent that some causes of death were mentioned on death certificates, but not as the underlying cause in Canada, Wilkins et al.[212] examined death records from provinces which had multiple cause of death data from 1990 to 1993. Table C.1 presents the causes of death that had the highest and lowest ratios of mentions to selections as underlying cause in Canada from 1990 to 1993.

Table C.1: Causes of death with the highest and lowest ratio of mentions to selection as the underlying cause of death

Cause	Death certificates with any mention	Selected as underlying cause	Ratio of mentions to underlying cause	Average age at death
Highest ratios				
Septicaemia	3,661	644	5.68	72.5
Nephritis, nephrotic syndrome, nephrosis	8,958	1,936	4.63	75.7
Diabetes mellitus	11,677	3,269	3.57	75.4
Lowest ratios				
Motor vehicle traffic accidents	3,292	3,238	1.02	38.1

Source: Wilkins et al.[212]

This table suggests that the mortality trends for the causes with the highest ratios should be interpreted with caution. Wilkins et al.[212] also found a strong positive association between the mentioning of diseases of the heart and diabetes mellitus death certificates (odds ratio 2.70, 95%CI 2.55-2.86).

For certain avoidable causes of death, certification and coding error likely did not influence the mortality trends observed in this study. Goldacre[153] showed that greater than 75% of deaths from lung cancer, breast cancer, cervical cancer, leukaemia, ischaemic heart disease, and cerebrovascular disease were recorded as the hospital admission diagnosis and the underlying cause of death in Oxford. Johansson and Westerling[237] demonstrated that greater than 80% of deaths from female breast cancer, lung cancer, myocardial infarction, and motor vehicle accidents were recorded as the hospital discharge diagnosis and the underlying cause of death in Sweden. Guibert et al.[291] and Goldarcre et al.[292] demonstrated that variations in death certificate coding for myocardial infarction did not influence geographic or temporal mortality trends in Canada or Sweden, respectively. Wilkins et al.[212] found that 98% of death certificates that mentioned motor vehicle accidents cite this as the underlying cause.

Competing Causes of Death

There is an association between certain causes of death, where if a person was saved from dying from one cause, he or she would be at a higher risk of dying from another "competing" cause compared to the average population.[239,242,243,293] This phenomenon can be attributed to the common risk factors some causes of death share.[239,244,293] For example, associations could be expected to occur between lung cancer, ischaemic heart disease and chronic obstructive lung disease because of the risk of dying from these causes is higher among smokers. Reducing the number of persons who die from one cause will sometimes increase the number of persons who die from a competing cause.

Additionally, in cases where two or more conditions are present at the time of death, eliminating a non-underlying causes may reduce the risk of dying from the underlying causes of death.[239,242] For instance, ischaemic heart disease may be a comorbid condition and competing cause of death for a person dying from chronic obstructive lung disease (COPD). If the contribution of ischaemic heart disease to deleterious health were eliminated, this person's risk of dying from COPD may be lessened.[239]

In the Netherlands, Mackenbach et al.[293] compared the prevalence of competing causes of death between underlying causes of death occurring in the Netherlands in 1990. Causes of death were considered competing if they met the following defined criteria: 1) the conditions could not be a complication or side-effect of the underlying or other competing causes of death, 2) the condition or its consequences had a chronic nature, and 3) the condition had the potential to develop into a new underlying cause of death if the original underlying cause were eliminated, or could give rise to the disease that in turn could develop into a new underlying cause. Competing causes that were identified for more than 1% of deaths were (in order of frequency) diabetes mellitus, ischaemic heart disease, cerebrovascular disease, hypertensive diseases, and nephritis, nephrosis. Diabetes mellitus and hypertensive disease were likely to be mentioned when cardiovascular diseases were the underlying cause of death. Strong positive associations are also apparent between ischaemic heart disease, diabetes, hypertensive disease and cerebrovascular disease.[293]

Implications

Inaccuracies and important variations in cause of death certification and coding exist, particularly for decedents who were older and with multiple causes. However, the analyses used in this study are restricted to deaths within defined age groups. For example, only the deaths of persons less than 75 years of age were considered. Goldacre[153] demonstrated that the proportion of hospital discharges diagnoses that are mentioned as the underlying cause of death increased when only deaths under the age of 75 were considered. Furthermore, the analyses of diabetes mellitus, asthma and leukaemia are restricted to deaths under the ages of 50, 50, and 15, respectively. Although the impact of these restrictions cannot be estimated, it is reasonable to assume that the accuracy of the underlying cause of death certification and coding for these causes are enhanced by the age restrictions.

Determining the underlying cause for deaths from multiple causes is problematic, potentially rendering mortality data misleading. The usefulness of the underlying cause of death depends on the cause of death being studied. In general, diseases which have a high case fatality rate, are rapidly fatal, are likely to be present alone, and are relatively easily diagnosed, are most likely to be recorded accurately on a death certificate as an underlying cause of death.[123,279] For example, the mortality trends for all cancers, cerebrovascular disease, motor vehicle accidents, congenital cardiovascular anomalies, asthma, and pneumonia can be assumed to be reasonably accurate. On the other hand, the impact of certain causes of death, such as ischaemic heart disease, may have been overemphasized. Furthermore, the importance of avoidable causes such as diabetes and hypertensive disease may have been overlooked in this study. Since these conditions are associated with ischaemic heart disease due to common risk factors such as smoking and diet, interventions targeted at these common risk factors may have a synergistic impact on mortality disparity related to these conditions.

Despite their limitations, mortality data are an inexpensive and readily available source of information. Furthermore, mortality data have several compensatory strengths. These include that almost all deaths in Canada are registered, data collection methods and definitions are standardized, and time trends as well as regional variations can be investigated.[98,282,294] The results of mortality analyses are not meant to explain phenomena, but rather signal areas that warrant more detailed investigations.[76,295] As Kleinman[294] noted, "viewed in proper context and used with care, vital statistics represent an invaluable source of data on the nation's health".

Appendix D Age-Standardized Period Expected Years of Life Lost and Standard Errors by Neighbourhood Income Quintile

Table D.1: Age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996

							Q5-Q1		QT-Q1	
Year	QT	Q1	Q2	Q3	Q4	Q5	RR	RD	RR	RD
All Causes (0-74)										
Males										
1971	16,989.44	13,012.56	14,135.93	15,970.83	16,807.13	22,252.42	1.71	9,239.86	1.31	3,976.88
1986	12,101.54	9,081.87	9,972.24	11,195.10	12,409.02	16,787.15	1.85	7,705.28	1.33	3,019.67
1991	10,554.66	7,866.99	8,710.24	9,740.27	11,300.77	15,164.21	1.93	7,297.22	1.34	2,687.67
1996	9,658.89	7,274.99	8,244.11	8,928.75	9,866.85	13,653.28	1.88	6,378.28	1.33	2,383.89
Females										
1971	10,301.74	8,413.25	8,493.14	10,092.89	10,561.95	12,715.30	1.51	4,302.05	1.22	1,888.49
1986	7,311.31	6,272.90	6,390.23	6,807.49	7,408.12	9,134.36	1.46	2,861.46	1.17	1,038.41
1991	6,393.31	5,394.86	5,914.45	5,886.00	6,532.73	8,173.03	1.51	2,778.17	1.19	998.46
1996	6,096.82	5,067.06	5,547.78	5,571.78	6,291.69	7,746.82	1.53	2,679.77	1.20	1,029.76
Intestinal infections (0-14)										
Males										
1971	13.16	3.96	10.35	23.43	17.45	10.02	2.53	6.06	3.32	9.20
1986	1.04	0	0	5.23	0	0	0	0	0	1.04
1991	0	0	0	0	0	0	0	0	0	0
1996	0.99	0	0	5.05	0	0	0	0	0	0.99
Females										
1971	16.00	7.53	6.80	19.29	19.43	25.72	3.42	18.19	2.13	8.48
1986	3.55	0	0	0	12.40	5.94	0	5.94	0	3.55
1991	0	0	0	0	0	0	0	0	0	0
1996	3.16	0	0	0	16.57	0	0	0	0	3.16
Tuberculosis (0-74)										
Males										
1971	55.29	24.91	14.26	37.66	68.57	121.66	4.88	96.76	2.22	30.39
1986	10.64	3.28	2.69	10.09	16.59	18.92	5.78	15.65	3.25	7.36
1991	7.75	0	0	4.48	5.70	28.12	0	28.12		7.75
1996	5.15	0.90	3.22	1.77	4.58	15.81	17.54	14.91	5.71	4.24
Females										
1971	32.22	20.90	16.18	22.30	31.50	61.11	2.92	40.21	1.54	11.33
1986	4.04	3.27	3.06	0	1.93	12.97	3.97	9.70	1.24	0.77
1991	6.50	0	9.15	7.38	7.71	8.08	0	8.08		6.50
1996	3.33	1.31	7.72	2.38	1.17	3.81	2.90	2.50	2.54	2.02
Diptheria (0-74)										
Males										
1971	0.43	0	0	0	0	0	0	0	0	0.43
1991	0.46	0	0	0	0	2.75	0	2.75	0	0.46
Females										
1971	1.36	0	0	0	0	6.33	0	6.33	0	1.36
1991	0	0	0	0	0	0	0	0	0	0
Whooping cough (0-14)										
Males										
1971	0	0	0	0	0	0	0	0	0	0
1996	0.99	0	5.18	0	0	0	0	0	0	0.99
Females										
1971	1.35	0	0	0	6.54	0	0	0	0	1.35
1996	1.09	5.54	0	0	0	0	0	-5.54	0.20	-4.45
Tetanus (0-74)										
(None)	0	0	0	0	0	0	0	0	0	0
Septicaemia (0-74)										
Males										
1971	15.96	6.80	24.32	1.97	13.53	26.10	3.84	19.31	2.35	9.17
1986	20.41	21.41	6.36	16.29	25.26	28.82	1.35	7.41	0.95	-1.00
1991	27.20	31.76	8.05	29.12	23.49	42.46	1.34	10.71	0.86	-4.56
1996	34.67	23.41	29.50	29.01	47.95	44.68	1.91	21.27	1.48	11.25
Females										
1971	859.77	1,097.54	51.68	947.74	911.03	869.15	0.79	-228.39	0.78	-237.76
1986	430.10	314.03	210.76	58.32	770.83	760.73	2.42	446.70	1.37	116.07
1991	568.98	313.45	669.23	384.23	480.14	929.14	2.96	615.69	1.82	255.53
1996	603.11	510.01	834.44	484.29	429.42	645.20	1.27	135.19	1.18	93.10

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, RR: rate ratio, RD: rate difference

Table D.1: Age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

Year	QT	Q1	Q2	Q3	Q4	Q5	Q5-Q1 RR	Q5-Q1 RD	QT-Q1 RR	QT-Q1 RD
Poliomyelitis (0-74)										
Males										
1971	1.76	0	7.13	2.21	0	0	0	0	0	1.76
Females										
1971	4.43	4.46	0	3.11	4.85	10.57	2.37	6.11	0.99	-0.03
Measles (1-14)										
Males										
1971	2.91	7.91	0	5.61	0	0	0	-7.91	0.37	-5.00
Females										
1971	3.40	10.17	0	6.17	0	0	0	-10.17	0.33	-6.76
Syphylis (0-74)										
Males										
1971	2.46	0	0	0	0	10.42	0	10.42	0	2.46
1986	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0
Females										
1971	1.45	3.32	0	0	0	4.32	1.30	1.00	0.44	-1.87
1986	0.19	0	0	0.93	0	0	0	0	0	0.19
1991	0	0	0	0	0	0	0	0	0	0
1996	0.27	0	1.45	0	0	0	0	0	0	0.27
Other bacterial infections (0-74)										
Males										
1971	49.07	15.35	22.06	45.61	37.10	116.27	7.57	100.91	3.20	33.71
1986	19.50	12.67	20.48	21.84	2.90	35.87	2.83	23.20	1.54	6.82
1991	11.43	6.34	19.41	10.15	1.20	18.71	2.95	12.37	1.80	5.09
1996	10.70	7.34	4.74	11.82	21.89	9.94	1.35	2.60	1.46	3.36
Females										
1971	33.04	26.24	15.33	9.30	57.50	46.71	1.78	20.47	1.26	6.80
1986	17.35	7.81	15.37	10.11	25.63	28.38	3.63	20.56	2.22	9.53
1991	13.42	23.58	2.27	12.46	8.81	18.40	0.78	-5.17	0.57	-10.16
1996	8.83	10.60	11.71	1.32	4.46	13.00	1.23	2.40	0.83	-1.76
Osteomyelitis and periostitis (0-74)										
Males										
1971	1.82	0	0	2.21	4.81	1.92	0	1.92	0	1.82
1986	1.77	3.16	4.72	0	1.92	0	0	-3.16	0.56	-1.39
1991	0.49	1.24	0	0	1.45	0	0	-1.24	0.39	-0.75
1996	0	0	0	2.53	0	1.77	0	1.77	0	0.88
Females										
1971	2.26	0	0	0	1.83	9.56	0	9.56	0	2.26
1986	0.19	0	0	0	0.80	0	0	0	0	0.19
1991	0.22	0	1.24	0	0	0	0	0	0	0.22
1996	0.57	0	0	1.70	0.91	0	0	0	0	0.57
Malignant neoplasm of the tracha, bronchus and lung (0-74)										
Males										
1971	976.19	749.34	738.17	891.75	1,020.53	1,282.52	1.71	533.18	1.30	226.85
1986	813.28	689.63	863.51	969.48	1,077.53	1,451.93	2.11	762.30	1.50	341.88
1991	947.55	694.41	739.06	881.15	1,052.52	1,357.45	1.95	663.04	1.36	253.14
1996	813.28	605.82	725.15	756.45	875.68	1,110.34	1.83	504.52	1.34	207.46
Females										
1971	199.15	168.75	190.86	137.61	255.77	224.03	1.33	55.28	1.18	30.40
1986	463.26	358.81	431.18	447.63	465.64	580.04	1.62	221.23	1.29	104.45
1991	525.25	438.25	493.60	495.05	553.36	628.85	1.43	190.59	1.20	86.99
1996	574.49	462.01	550.94	572.05	599.53	667.64	1.45	205.63	1.24	112.49
Malignant neoplasm of the skin [non melanoma] (0-74)										
Males										
1971	8.63	2.89	9.56	12.50	10.81	5.47	1.89	2.58	2.99	5.74
1986	5.16	4.87	1.23	1.04	7.98	11.11	2.28	6.24	1.06	0.29
1991	7.55	4.44	3.84	6.04	10.51	12.73	2.87	8.29	1.70	3.11
1996	9.20	8.61	11.47	9.77	10.39	6.20	0.72	-2.42	1.07	0.59
Females										
1971	6.86	5.90	0	4.40	12.54	8.20	1.39	2.30	1.16	0.96
1986	1.83	3.82	1.16	0	3.49	0.71	0.19	-3.10	0.48	-1.98
1991	2.57	0	1.48	1.98	3.12	5.99	0	5.99	0	2.57
1996	2.91	4.44	4.07	2.04	1.50	2.65	0.60	-1.79	0.65	-1.54

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, RR: rate ratio, RD: rate difference

Table D.1: Age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

Year	QT	Q1	Q2	Q3	Q4	Q5	Q5-Q1 RR	Q5-Q1 RD	QT-Q1 RR	QT-Q1 RD
Malignant neoplasm of the female breast (25-74)										
Females										
1971	700.49	734.08	674.42	679.63	679.87	692.94	0.94	-41.14	0.95	-33.59
1986	692.41	710.42	685.59	666.88	695.21	684.96	0.96	-25.46	0.97	-18.01
1991	614.66	643.46	673.67	579.78	524.67	639.65	0.99	-3.81	0.96	-28.80
1996	575.90	628.39	518.07	558.48	585.89	585.68	0.93	-42.71	0.92	-52.49
Malignant neoplasm of the cervix uteri (15-74)										
Females										
1971	170.36	82.94	103.54	171.62	202.75	274.75	3.31	191.81	2.05	87.42
1986	79.63	42.20	71.67	70.65	87.03	126.52	3.00	84.32	1.89	37.43
1991	73.06	55.96	61.66	73.93	53.51	125.74	2.25	69.78	1.31	17.10
1996	61.62	46.72	66.92	72.49	44.86	80.19	1.72	33.47	1.32	14.90
Malignant neoplasm of the uterus [except cervix uteri] (15-74)										
Females										
1971	76.04	35.63	61.45	75.88	85.37	107.35	3.01	71.72	2.13	40.41
1986	48.79	40.44	45.90	51.60	39.21	61.93	1.53	21.49	1.21	8.35
1991	49.47	38.30	51.65	45.66	53.62	55.56	1.45	17.26	1.29	11.16
1996	43.19	32.92	47.46	37.21	47.91	48.68	1.48	15.76	1.31	10.27
Malignant neoplasm of the testis (0-74)										
Males										
1971	33.68	18.14	69.09	20.03	34.18	29.52	1.63	11.38	1.86	15.54
1986	13.67	10.63	15.83	9.49	9.39	18.88	1.78	8.25	1.29	3.04
1991	10.38	8.30	14.34	13.31	2.78	13.31	1.60	5.01	1.25	2.08
1996	8.95	9.48	0.86	14.08	11.95	9.33	0.98	-0.15	0.94	-0.53
Hodgkin's disease (0-74)										
Males										
1971	81.41	79.91	83.85	83.05	95.65	63.31	0.79	-16.60	1.02	1.50
1986	30.05	22.55	29.93	34.17	37.59	24.87	1.10	2.32	1.33	7.49
1991	21.70	14.94	30.70	9.74	25.04	31.51	2.11	16.57	1.45	6.76
1996	15.88	25.23	24.54	11.12	12.91	9.84	0.39	-15.39	0.63	-9.35
Females										
1971	47.33	49.26	29.47	53.04	46.84	53.49	1.09	4.23	0.96	-1.94
1986	15.99	21.81	14.78	17.93	9.49	16.56	0.76	-5.25	0.73	-5.82
1991	17.78	22.24	12.79	11.81	17.88	24.68	1.11	2.44	0.80	-4.46
1996	9.74	17.71	11.59	9.23	7.29	5.95	0.34	-11.76	0.55	-7.97
Leukaemia (0-74)										
Males										
1971	57.31	62.86	35.85	39.46	79.25	58.00	0.92	-4.86	0.91	-5.55
1986	25.94	17.80	36.49	39.25	10.86	22.94	1.29	5.14	1.46	8.14
1991	20.72	11.58	37.90	17.56	25.00	11.70	1.01	0.12	1.79	9.14
1996	18.33	17.80	33.64	8.56	4.81	24.49	1.38	6.69	1.03	0.53
Females										
1971	56.51	58.22	42.93	24.68	54.20	100.97	1.73	42.74	0.97	-1.71
1986	24.83	25.25	26.15	16.53	25.06	31.72	1.26	6.46	0.98	-0.43
1991	15.30	7.98	14.19	15.20	22.20	19.01	2.38	11.03	1.92	7.32
1996	17.11	11.90	9.64	19.05	26.68	20.78	1.75	8.88	1.44	5.22
Diseases of the thyroid (0-74)										
Males										
1971	5.86	3.58	6.15	7.39	4.39	7.14	2.00	3.57	1.64	2.28
1986	2.23	3.16	0	1.32	4.27	2.59	0.82	-0.57	0.70	-0.93
1991	0.22	0	0	1.03	0	0	0	0	0	0.22
1996	1.35	0	1.45	0	3.89	0.75	0	0.75	0	1.35
Females										
1971	9.77	12.06	7.00	4.40	7.22	14.48	1.20	2.42	0.81	-2.29
1986	2.06	0	4.56	0	3.18	2.29	0	2.29	0	2.06
1991	1.65	0	1.48	3.59	0.90	1.64	0	1.64	0	1.65
1996	2.07	0	0	0.68	1.57	7.54	0	7.54	0	2.07

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile,
Q5-Q1: poorest quintile-richest quintile comparison,
QT-Q1: total population-richest quintile comparison, RR: rate ratio, RD: rate difference

Table D.1: Age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

Year	QT	Q1	Q2	Q3	Q4	Q5	Q5-Q1		QT-Q1	
							RR	RD	RR	RD
Diabetes mellitus (0-49)										
Males										
1971	48.88	35.29	37.85	57.15	45.83	57.38	1.63	22.09	1.39	13.59
1986	37.23	17.57	48.24	34.91	30.82	50.68	2.88	33.11	2.12	19.66
1991	34.69	17.13	28.30	29.84	40.40	65.31	3.81	48.18	2.03	17.56
1996	30.21	17.49	22.60	16.77	39.31	48.95	2.80	31.45	1.73	12.72
Females										
1971	40.75	14.14	10.25	48.48	56.57	79.94	5.66	65.81	2.88	26.61
1986	17.84	7.33	16.23	13.40	22.73	31.61	4.31	24.28	2.43	10.51
1991	18.50	9.24	10.69	17.41	26.93	34.38	3.72	25.14	2.00	9.26
1996	15.99	16.79	12.06	7.98	13.50	36.20	2.16	19.40	0.95	-0.80
Deficiency anaemia (0-74)										
Males										
1971	1.83	0	0	0	3.12	4.96	0	4.96	0	1.83
1986	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	0	0	0	0	0	0	0
Females										
1971	2.00	0	1.94	4.40	2.14	1.16	0	1.16	0	2.00
1986	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0
1996	1.07	1.57	0	0	0	3.01	1.92	1.44	0.68	-0.50
Epilepsy (0-74)										
Males										
1971	43.90	24.59	30.51	45.24	39.81	66.64	2.71	42.06	1.79	19.31
1986	37.86	32.91	23.36	22.63	48.44	57.10	1.74	24.19	1.15	4.95
1991	29.04	9.90	26.49	25.21	35.76	50.49	5.10	40.59	2.93	19.14
1996	26.90	9.41	21.46	36.82	34.93	33.07	3.51	23.66	2.86	17.48
Females										
1971	29.53	13.84	8.30	23.68	30.14	72.75	5.26	58.91	2.13	15.69
1986	25.49	23.77	28.48	22.10	20.91	31.13	1.31	7.36	1.07	1.72
1991	18.47	11.71	12.68	13.27	23.39	32.36	2.76	20.65	1.58	6.75
1996	18.90	21.70	23.40	6.70	5.66	39.78	1.83	18.08	0.87	-2.80
Active rheumatic fever (0-74)										
Males										
1971	2.46	0	5.88	6.22	0	0	0	0	0	2.46
1986	0	0	0	0	0	0	0	0	0	0
1991	0.63	0	0	0	0	2.38	0	2.38	0	0.63
1996	0	0	0	0	0	0	0	0	0	0
Females										
1971	2.44	0	4.66	4.59	0	2.53	0	2.53	0	2.44
1986	0	0	0	0	0	0	0	0	0	0
1991	0.87	2.04	0	0	0	2.10	1.03	0.06	0.43	-1.17
1996	0.77	0	0	0	0	0	0	0	0	0.77
Chronic rheumatic heart disease (0-74)										
Males										
1971	144.03	100.50	130.09	110.67	167.78	194.56	1.94	94.05	1.43	43.52
1986	23.89	16.12	17.88	21.32	22.40	43.89	2.72	27.77	1.48	7.77
1991	14.35	10.48	9.89	16.13	14.01	19.18	1.83	8.70	1.37	3.87
1996	12.35	7.94	10.18	10.29	11.97	20.32	2.56	12.38	1.56	4.41
Females										
1971	155.52	121.08	120.77	172.83	156.76	213.13	1.76	92.05	1.28	34.45
1986	37.32	28.71	39.67	35.06	45.73	33.64	1.17	4.93	1.30	8.61
1991	22.00	9.12	22.11	22.41	23.80	28.91	3.17	19.79	2.41	12.88
1996	24.44	16.27	18.47	28.36	25.24	33.72	2.07	17.45	1.50	8.17
Hypertensive disease (35-74)										
Males										
1971	72.01	71.14	40.61	72.12	75.52	92.27	1.30	21.13	1.01	0.87
1986	42.14	27.02	35.47	32.80	47.67	60.56	2.24	33.54	1.56	15.12
1991	25.24	11.84	20.84	31.43	25.40	31.78	2.68	19.94	2.13	13.40
1996	30.83	22.08	21.86	26.99	31.51	49.09	2.22	27.01	1.40	8.75
Females										
1971	59.01	37.94	63.77	50.28	87.39	49.17	1.30	11.23	1.56	21.07
1986	30.88	20.36	19.86	32.32	29.29	46.53	2.29	26.18	1.52	10.52
1991	25.06	24.02	15.71	25.70	22.82	38.22	1.59	14.20	1.04	1.05
1996	15.87	15.91	6.97	11.98	18.37	24.72	1.55	8.82	1.00	-0.04

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile,
Q5-Q1: poorest quintile-richest quintile comparison,
QT-Q1: total population-richest quintile comparison, RR: rate ratio, RD: rate difference

Table D.1: Age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1	
Year	QT	Q1	Q2	Q3	Q4	Q5	RR	RD	RR	RD
Ischaemic heart disease (35-74)										
Males										
1971	4,393.68	3,669.36	3,747.46	4,243.74	4,155.04	5,469.55	1.49	1,800.19	1.20	724.32
1986	2,508.67	1,906.88	2,188.31	2,355.75	2,762.66	3,148.13	1.65	1,241.25	1.32	601.79
1991	1,785.93	1,371.70	1,634.55	1,731.43	1,869.88	2,310.77	1.68	939.07	1.30	414.22
1996	1,485.33	1,148.30	1,268.98	1,434.06	1,596.88	1,910.61	1.66	762.31	1.29	337.03
Females										
1971	1,539.27	1,247.50	1,314.40	1,417.18	1,535.46	1,942.08	1.56	694.58	1.23	291.77
1986	882.39	684.82	737.00	837.82	891.33	1,127.02	1.65	442.20	1.29	197.57
1991	664.72	489.05	542.39	618.33	702.32	914.92	1.87	425.87	1.36	175.67
1996	538.78	374.56	453.54	484.06	542.54	804.79	2.15	430.23	1.44	164.22
Cerebrovascular diseases (35-74)										
Males										
1971	681.04	605.94	552.28	635.53	689.29	818.59	1.35	212.64	1.12	75.10
1986	354.34	240.01	308.11	314.52	348.68	532.02	2.22	292.01	1.48	114.33
1991	283.53	203.59	238.73	260.70	293.05	419.40	2.06	215.81	1.39	79.94
1996	242.32	155.46	225.04	215.00	254.61	360.82	2.32	205.36	1.56	86.85
Females										
1971	582.39	545.06	503.25	614.91	536.22	655.62	1.20	110.56	1.07	37.32
1986	301.33	245.30	273.35	265.93	307.93	370.07	1.51	124.77	1.23	56.03
1991	237.76	211.82	202.21	212.34	234.10	321.54	1.52	109.72	1.12	25.93
1996	214.94	171.18	221.88	191.39	211.12	267.41	1.56	96.23	1.26	43.76
Acute respiratory infections [except influenza] (0-74)										
Males										
1971	6.31	7.91	5.51	16.83	0	0	0	-7.91	0.80	-1.60
1986	0	0	0	0	0	0	0	0	0	0
1991	2.85	4.16	4.45	4.85	0	0	0	-4.16	0.68	-1.32
1996	0	0	0	0	0	4.52	0	4.52	0	0.89
Females										
1971	8.24	6.26	0	18.51	16.93	0	0	-6.26	1.32	1.99
1986	1.16	0	0	5.81	0	0	0	0	0	1.16
1991	3.12	0	9.59	0	0	5.84	0	5.84	0	3.12
1996	1.93	3.87	4.82	0	0	0	0	-3.87	0.50	-1.94
Influenza (0-74)										
Males										
1971	18.21	22.89	20.11	10.10	24.37	14.64	0.64	-8.25	0.80	-4.68
1986	1.47	2.96	0	0	4.42	0.91	0.31	-2.05	0.50	-1.48
1991	1.09	0	1.20	2.99	0	1.04	0	1.04	0	1.09
1996	1.06	1.13	0	0	0	5.12	4.52	3.98	0.93	-0.07
Females										
1971	20.35	2.61	12.43	29.17	21.31	31.96	12.26	29.35	7.81	17.75
1986	3.56	0	4.08	5.11	6.53	1.96	0	1.96	0	3.56
1991	1.22	1.76	0	0	0	4.31	2.45	2.55	0.69	-0.54
1996	0.90	1.56	3.46	0	0	0	0	-1.56	0.58	-0.66
Pneumonia (0-74)										
Males										
1971	365.77	208.09	281.14	266.66	352.36	619.63	2.98	411.54	1.76	157.68
1986	139.64	69.70	122.89	100.31	151.43	245.26	3.52	175.56	2.00	69.94
1991	107.45	47.45	81.91	94.93	116.34	194.75	4.10	147.31	2.26	60.00
1996	112.46	83.13	68.10	106.07	105.81	202.15	2.43	119.01	1.35	29.33
Females										
1971	262.93	163.45	163.60	270.10	303.10	373.17	2.28	209.72	1.61	99.48
1986	87.26	49.16	41.84	61.84	112.45	164.74	3.35	115.57	1.77	38.09
1991	69.62	50.80	38.49	81.36	73.38	104.29	2.05	53.50	1.37	18.82
1996	68.37	60.39	61.51	65.16	60.69	94.30	1.56	33.91	1.13	7.98

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, RR: rate ratio, RD: rate difference

Table D.1: Age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

Year	QT	Q1	Q2	Q3	Q4	Q5	Q5-Q1 RR	Q5-Q1 RD	QT-Q1 RR	QT-Q1 RD
Bronchitis (0-74)										
Males										
1971	4.55	13.33	0	6.39	0	4.31	0.32	-9.02	0.34	-8.78
1986	3.32	0	4.97	0	2.48	8.14	0	8.14	0	3.32
1991	2.52	0	0	2.96	3.40	5.43	0	5.43	0	2.52
1996	0.59	0.90	0	0	0	2.48	2.75	1.58	0.66	-0.31
Females										
1971	8.78	17.05	0	7.12	0	19.91	1.17	2.86	0.51	-8.27
1986	1.25	1.49	0	1.87	2.02	1.06	0.72	-0.42	0.84	-0.24
1991	2.73	1.51	2.27	0.99	3.26	4.86	3.22	3.35	1.81	1.22
1996	2.00	0	0	8.30	0.91	0.62	0	0.62	0	2.00
Emphysema (0-74)										
Males										
1971	161.91	100.65	102.96	160.79	172.81	231.48	2.30	130.83	1.61	61.26
1986	56.01	29.10	34.92	53.27	67.27	89.35	3.07	60.25	1.92	26.91
1991	47.53	26.59	32.58	43.70	52.24	77.64	2.92	51.05	1.79	20.94
1996	31.70	23.93	26.56	30.51	33.38	43.44	1.82	19.51	1.33	7.78
Females										
1971	29.72	18.80	34.86	27.64	24.52	42.50	2.26	23.70	1.58	10.92
1986	26.09	20.73	18.51	20.35	39.86	26.13	1.26	5.40	1.26	5.36
1991	22.81	19.02	10.35	26.76	29.48	25.22	1.33	6.20	1.20	3.79
1996	22.22	19.47	18.78	27.74	27.45	16.92	0.87	-2.55	1.14	2.75
Asthma (0-49)										
Males										
1971	10.29	18.34	8.36	5.97	4.79	15.30	0.83	-3.04	0.56	-8.05
1986	26.69	6.51	39.17	25.25	25.93	33.12	5.08	26.61	4.10	20.18
1991	14.72	0	24.67	9.56	19.44	23.36	0	23.36	0	14.72
1996	10.22	20.32	0	10.69	11.71	9.80	0.48	-10.52	0.50	-10.10
Females										
1971	12.63	8.90	8.66	6.57	11.48	26.65	2.99	17.75	1.42	3.73
1986	13.88	14.00	26.15	7.09	14.39	6.48	0.46	-7.51	0.99	-0.12
1991	17.69	15.06	16.96	22.18	17.37	20.86	1.39	5.81	1.17	2.63
1996	12.35	10.79	14.99	15.22	14.11	9.34	0.87	-1.45	1.14	1.56
Gastric and duodenal [peptic] ulcer (0-74)										
Males										
1971	106.96	55.54	69.00	89.33	110.80	175.71	3.16	120.18	1.93	51.42
1986	32.15	12.78	17.06	18.70	40.83	66.34	5.19	53.56	2.52	19.37
1991	21.51	11.35	16.98	13.31	24.89	40.08	3.53	28.74	1.89	10.16
1996	16.41	9.55	7.32	21.71	20.64	23.94	2.51	14.39	1.72	6.86
Females										
1971	33.42	27.32	46.99	17.60	18.51	48.16	1.76	20.84	1.22	6.09
1986	23.41	16.15	18.22	22.77	23.97	37.39	2.32	21.24	1.45	7.27
1991	11.78	6.28	19.49	7.71	12.74	12.89	2.05	6.61	1.88	5.50
1996	8.84	4.83	8.63	8.64	8.59	13.75	2.85	8.93	1.83	4.01
Appendicitis (0-74)										
Males										
1971	9.12	2.70	18.85	4.70	10.34	10.14	3.75	7.44	3.38	6.42
1986	3.26	3.28	0	4.35	2.48	6.65	2.03	3.37	0.99	-0.02
1991	2.82	3.20	0	3.93	2.67	3.82	1.19	0.62	0.88	-0.38
1996	1.31	1.31	2.02	0.76	2.29	0	0	-1.31	1.00	0.00
Females										
1971	9.72	13.88	0	18.85	9.63	4.93	0.35	-8.96	0.70	-4.16
1986	2.22	1.49	3.32	0	6.27	1.06	0.72	-0.42	1.50	0.74
1991	0.99	0	0	3.59	0	0.95	0	0.95	0	0.99
1996	2.43	0	2.73	5.62	2.42	1.32	0	1.32	0	2.43

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile,
Q5-Q1: poorest quintile-richest quintile comparison,
QT-Q1: total population-richest quintile comparison, RR: rate ratio, RD: rate difference

Table D.1: Age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1	
Year	QT	Q1	Q2	Q3	Q4	Q5	RR	RD	RR	RD
Abdominal hernia (0-74)										
Males										
1971	31.70	30.46	22.21	20.94	23.30	57.74	1.90	27.28	1.04	1.24
1986	6.06	0	0	5.56	14.67	9.52	0	9.52	0	6.06
1991	3.54	2.87	3.48	4.95	3.04	3.16	1.10	0.28	1.23	0.67
1996	5.32	4.44	3.68	5.96	7.61	5.03	1.13	0.59	1.20	0.88
Females										
1971	16.50	3.27	30.54	14.77	16.93	13.43	4.11	10.16	5.05	13.24
1986	2.74	6.04	3.06	2.84	0	2.13	0.35	-3.91	0.45	-3.30
1991	1.28	2.63	1.69	0.78	0.69	1.28	0.49	-1.35	0.49	-1.35
1996	2.58	0.94	2.01	2.16	6.16	1.60	1.69	0.65	2.73	1.63
Ilieus without hernia (0-74)										
Males										
1971	16.57	2.46	13.47	14.67	18.15	28.34	11.54	25.88	6.75	14.12
1986	7.54	8.65	4.55	9.80	0	8.76	1.01	0.11	0.87	-1.11
1991	9.14	9.11	10.60	4.36	12.84	9.25	1.02	0.14	1.00	0.04
1996	7.33	0	0.86	5.18	10.39	19.85	0	19.85	0	7.33
Females										
1971	33.36	17.30	35.05	34.37	39.52	37.90	2.19	20.60	1.93	16.06
1986	10.06	8.16	10.97	9.02	7.35	14.61	1.79	6.45	1.23	1.90
1991	6.92	8.34	4.99	3.61	11.09	6.75	0.81	-1.59	0.83	-1.42
1996	5.91	7.40	2.01	2.35	6.85	10.47	1.42	3.07	0.80	-1.49
Cirrhosis of the liver (0-74)										
Males										
1971	390.14	181.52	211.49	335.18	376.65	753.89	4.15	572.37	2.15	208.62
1986	281.47	180.76	144.21	293.33	280.40	496.21	2.75	315.45	1.56	100.71
1991	236.36	125.82	167.34	191.65	252.96	458.71	3.65	332.90	1.88	110.55
1996	198.82	110.29	145.20	168.69	224.92	349.95	3.17	239.66	1.80	88.53
Females										
1971	203.81	128.09	152.09	206.50	152.12	364.18	2.84	236.09	1.59	75.72
1986	125.29	88.51	100.86	117.61	132.27	181.41	2.05	92.90	1.42	36.78
1991	105.20	61.51	103.04	70.72	97.90	196.10	3.19	134.59	1.71	43.69
1996	75.02	62.90	65.23	83.34	75.70	84.93	1.35	22.03	1.19	12.12
Cholethiasis, Cholecystitis, and Cholangitis (0-74)										
Males										
1971	29.39	25.44	13.20	43.76	19.52	37.10	1.46	11.67	1.16	3.95
1986	8.83	7.94	6.93	4.69	7.81	16.31	2.05	8.37	1.11	0.89
1991	6.53	7.05	4.67	2.35	3.12	13.85	1.96	6.79	0.93	-0.52
1996	7.57	9.60	5.18	11.05	7.52	4.63	0.48	-4.97	0.79	-2.03
Females										
1971	32.37	32.74	19.48	21.30	44.78	38.28	1.17	5.55	0.99	-0.37
1986	5.34	12.17	3.06	1.25	2.41	9.55	0.79	-2.62	0.44	-6.83
1991	4.65	6.42	0	4.36	1.60	11.27	1.76	4.85	0.72	-1.77
1996	7.00	6.34	2.01	6.84	5.15	15.21	2.40	8.88	1.10	0.66
Nephritis and nephrosis (0-74)										
Males										
1971	74.57	45.91	62.71	49.39	49.34	153.13	3.34	107.21	1.62	28.66
1986	73.55	37.72	83.13	59.28	77.41	104.11	2.76	66.39	1.95	35.82
1991	53.65	21.90	58.35	47.65	68.84	70.03	3.20	48.13	2.45	31.74
1996	61.20	49.00	39.20	53.83	72.81	94.29	1.92	45.30	1.25	12.20
Females										
1971	45.90	44.08	33.17	40.41	38.31	65.19	1.48	21.11	1.04	1.83
1986	46.12	24.84	27.83	63.85	40.59	63.44	2.55	38.60	1.86	21.28
1991	45.43	36.16	46.61	32.65	44.69	67.20	1.86	31.04	1.26	9.28
1996	45.28	50.90	35.58	27.35	38.72	74.97	1.47	24.07	0.89	-5.62

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, RR: rate ratio, RD: rate difference

Table D.1: Age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1	
Year	QT	Q1	Q2	Q3	Q4	Q5	RR	RD	RR	RD
Infections of the urinary system (0-74)										
Males										
1971	36.82	36.50	13.65	41.20	34.58	49.31	1.35	12.81	1.01	0.31
1986	3.15	1.68	4.19	4.81	0	5.21	3.09	3.53	1.87	1.46
1991	4.14	3.42	1.07	1.68	0	13.94	4.08	10.52	1.21	0.72
1996	0.68	2.70	0	0	0	1.02	0.38	-1.69	0.25	-2.03
Females										
1971	31.19	21.48	16.67	29.54	46.52	34.34	1.60	12.86	1.45	9.71
1986	5.91	5.38	4.69	1.25	6.01	8.72	1.62	3.34	1.10	0.53
1991	6.15	3.55	2.27	0.78	5.10	20.30	5.72	16.75	1.73	2.60
1996	3.79	2.75	1.45	5.85	6.93	2.30	0.84	-0.45	1.38	1.04
Hyperplasia of the prostate (0-74)										
Males										
1971	10.22	6.16	6.76	10.53	6.60	15.39	2.50	9.23	1.66	4.06
1986	2.34	0	0	3.41	5.04	2.50	0	2.50	0	2.34
1991	0.19	0	0	0.89	0	0	0	0.00	0	0.19
1996	0.31	0	0.86	0	0	0.75	0	0.75	0	0.31
Maternal mortality [complications of pregnancy] (0-74)										
Females										
1971	20.71	18.53	5.63	17.20	21.42	40.57	2.19	22.04	1.12	2.18
1986	5.99	9.91	4.20	0	0	15.68	1.58	5.77	0.60	-3.92
1991	3.74	7.56	0	0	11.85	0	0	-7.56	0.49	-3.82
1996	5.57	5.33	9.17	2.46	2.34	8.58	1.61	3.25	1.04	0.24
Congenital cardiovascular anomalies (0-74)										
Males										
1971	235.46	153.69	211.37	212.11	275.02	288.07	1.87	134.39	1.53	81.77
1986	176.77	129.76	133.11	191.34	202.41	221.57	1.71	91.81	1.36	47.01
1991	134.17	113.11	149.71	124.05	133.69	145.88	1.29	32.77	1.19	21.06
1996	103.79	73.22	111.16	89.60	99.83	147.40	2.01	74.19	1.42	30.57
Females										
1971	211.85	198.63	151.48	245.37	222.26	230.84	1.16	32.21	1.07	13.22
1986	176.94	162.22	169.47	154.96	184.12	208.36	1.28	46.13	1.09	14.71
1991	109.88	81.88	138.57	100.06	115.23	116.83	1.43	34.95	1.34	28.00
1996	88.75	100.71	60.85	64.09	117.74	99.90	0.99	-0.81	0.88	-11.96
Congenital digestive anomalies (0-74)										
Males										
1971	41.79	40.79	60.83	41.25	31.38	35.37	0.87	-5.42	1.02	1.00
1986	4.55	5.38	0	11.95	0.00	5.33	0.99	-0.05	0.85	-0.83
1991	4.74	4.66	0	9.75	9.61	0	0	-4.66	1.02	0.08
1996	3.37	0.90	1.27	10.10	0	4.41	4.89	3.51	3.74	2.47
Females										
1971	33.05	22.59	27.19	25.84	39.22	41.14	1.82	18.56	1.46	10.47
1986	11.39	13.21	0	17.67	12.54	14.92	1.13	1.71	0.86	-1.83
1991	4.41	11.83	0	5.34	5.36	0	0	-11.83	0.37	-7.42
1996	7.41	10.00	5.73	11.24	9.11	0.98	0.10	-9.02	0.74	-2.59
Perinatal conditions										
Males										
1971	1,124.98	741.00	977.30	1,152.19	1,194.00	1,408.72	1.90	667.72	1.52	383.99
1986	467.71	360.26	367.69	484.03	473.15	612.86	1.70	252.60	1.30	107.45
1991	311.29	263.86	247.98	260.18	379.45	404.35	1.53	140.50	1.18	47.44
1996	339.86	203.44	382.77	356.62	272.63	454.13	2.23	250.68	1.67	136.42
Females										
1971	836.82	617.33	639.04	845.99	830.23	1,157.38	1.87	540.06	1.36	219.49
1986	340.32	265.29	284.72	308.85	374.28	451.17	1.70	185.88	1.28	75.03
1991	256.82	227.07	206.42	208.14	273.25	370.05	1.63	142.99	1.13	29.75
1996	269.91	204.82	239.85	284.94	280.62	330.21	1.61	125.39	1.32	65.09
Motor vehicle accidents (0-74)										
Males										
1971	1,217.11	1,002.42	1,194.77	1,325.61	1,250.23	1,170.28	1.17	167.86	1.21	214.69
1986	689.77	716.42	708.50	646.93	649.16	649.45	0.91	-66.97	0.96	-26.64
1991	550.00	609.52	567.10	473.09	573.10	539.15	0.88	-70.37	0.90	-59.52
1996	404.38	506.09	503.39	361.94	358.22	282.90	0.56	-223.19	0.80	-101.71
Females										
1971	517.91	457.38	416.26	609.93	611.79	435.43	0.95	-21.95	1.13	60.53
1986	296.20	368.85	240.84	269.20	244.35	315.26	0.85	-53.60	0.80	-72.66
1991	230.88	252.06	256.96	226.11	216.16	223.23	0.89	-28.83	0.92	-21.17
1996	175.31	164.67	203.25	142.73	173.17	167.53	1.02	2.86	1.06	10.64

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, RR: rate ratio, RD: rate difference

Table D.2: Standard errors of age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996

Year	QT	Q1	Q2	Q3	Q4	Q5	Q5-Q1 lnRR	Q5-Q1 RD	QT-Q1 RD
All Causes (0-74)									
Males									
1971	106.641	221.617	222.132	232.237	237.962	262.669	0.021	343.670	531.351
1986	75.621	150.316	153.176	164.329	171.321	199.718	0.020	249.965	338.347
1991	66.602	132.503	135.982	141.979	154.868	180.898	0.021	224.235	295.547
1996	62.091	123.644	131.433	134.232	138.298	164.112	0.021	205.477	267.869
Females									
1971	88.054	186.214	177.984	194.337	199.044	219.050	0.028	287.504	432.139
1986	61.905	132.768	129.310	131.290	140.245	157.329	0.027	205.864	283.562
1991	53.783	114.344	117.352	112.602	120.644	140.229	0.027	180.938	245.569
1996	50.954	105.075	110.367	107.177	116.269	129.724	0.027	166.940	221.551
Intestinal infections (0-14)									
Males									
1971	3.833	3.957	7.448	11.717	10.077	7.083	1.225	8.113	16.699
1986	1.039	0.003	0.003	5.231	0.003	0.003	.	0.004	3.890
1991	0.001	0.002	0.003	0.003	0.003	0.003	.	0.004	0.000
1996	0.987	0.002	0.002	5.049	0.003	0.003	.	0.004	4.216
Females									
1971	4.621	7.528	6.798	11.139	11.219	12.858	1.118	14.900	21.246
1986	2.052	0.003	0.003	0.003	8.772	5.936	.	5.936	8.274
1991	0.001	0.003	0.003	0.003	0.003	0.003	.	0.004	0.000
1996	1.828	0.003	0.003	0.003	9.571	0.003	.	0.004	7.415
Tuberculosis (0-74)									
Males									
1971	5.627	8.366	5.825	10.540	14.923	18.316	0.368	20.136	26.963
1986	1.853	2.318	1.906	3.604	5.780	5.378	0.762	5.856	8.885
1991	1.451	0.004	0.004	2.245	2.352	6.673		6.673	6.651
1996	1.204	0.901	1.884	1.264	2.393	5.132	1.051	5.210	4.869
Females									
1971	4.848	7.987	6.880	8.439	10.891	16.050	0.464	17.927	22.528
1986	1.218	2.322	2.165	0.004	1.385	5.697	0.835	6.152	5.844
1991	1.426	0.004	3.545	3.926	3.241	3.805		3.805	7.619
1996	0.903	1.312	3.588	1.404	0.830	1.748	1.100	2.186	4.322
Diptheria (0-74)									
Males									
1971	0.434	0.005	0.005	0.005	0.005	0.005	.	0.007	2.082
1991	0.461	0.004	0.004	0.004	0.004	2.752	.	2.752	1.507
Females									
1971	1.006	0.005	0.005	0.005	0.005	4.775	.	4.775	4.462
1991	0.002	0.004	0.004	0.004	0.004	0.005	.	0.006	0.000
Whooping cough (0-14)									
Males									
1971	0.001	0.003	0.003	0.003	0.003	0.003	.	0.004	0.000
1996	0.987	0.002	5.184	0.003	0.003	0.003	.	0.004	4.216
Females									
1971	1.350	0.003	0.003	0.003	6.537	0.003	.	0.004	6.324
1996	1.090	5.536	0.003	0.003	0.003	0.003	.	5.536	4.446
Tetanus (0-74)									
(none)	12.156	26.372	26.611	27.112	27.805	28.322	.	38.699	0.083
Septicaemia (0-74)									
Males									
1971	4.093	6.798	12.161	1.973	7.135	11.499	1.093	13.358	19.182
1986	3.129	8.108	3.188	5.786	9.238	7.422	0.458	10.992	14.258
1991	3.222	7.972	3.417	6.788	6.237	9.543	0.337	12.435	13.526
1996	3.751	7.688	8.686	7.562	9.749	8.850	0.383	11.722	15.185
Females									
1971	859.771	1,097.536	51.676	947.740	911.033	869.150	0.792	-228.386	0.783
1986	430.100	314.027	210.759	58.323	770.826	760.731	2.423	446.703	1.370
1991	568.984	313.454	669.230	384.230	480.145	929.142	2.964	615.688	1.815
1996	603.114	510.014	834.437	484.289	429.422	645.202	1.265	135.188	1.183

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, lnRR: natural logarithm of the rate ratio, RD: rate difference

Table D.2: Standard errors of age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1
Year	QT	Q1	Q2	Q3	Q4	Q5	lnRR	RD	RD
Poliomyelitis (0-74)									
Males									
1971	1.062	0.005	5.283	2.206	0.005	0.005	.	0.007	6.038
Females									
1971	2.011	4.463	0.005	3.114	4.854	7.594	1.231	8.809	7.642
Measles									
Males									
1971	1.694	5.597	0.003	5.611	0.003	0.003	.	5.597	6.361
Females									
1971	1.987	7.379	0.003	6.169	0.003	0.003	.	7.379	7.793
Syphylis (0-74)									
Males									
1971	1.418	0.005	0.005	0.005	0.005	6.456	.	6.456	7.359
1986	0.002	0.004	0.004	0.004	0.004	0.004	.	0.006	0.000
1991	0.002	0.004	0.004	0.004	0.004	0.004	.	0.006	0.000
1996	0.002	0.004	0.004	0.004	0.004	0.004	.	0.006	0.000
Females									
1971	0.838	3.318	0.005	0.005	0.005	3.098	1.231	4.539	4.728
1986	0.191	0.004	0.004	0.934	0.005	0.005	.	0.006	1.309
1991	0.002	0.004	0.004	0.004	0.004	0.005	.	0.006	0.000
1996	0.272	0.004	1.453	0.004	0.004	0.004	.	0.006	1.315
Other bacterial infections (0-74)									
Males									
1971	7.012	8.963	10.628	15.327	13.438	23.897	0.619	25.523	32.360
1986	4.140	6.738	9.596	9.887	2.154	12.649	0.638	14.332	16.407
1991	2.676	3.894	8.707	4.893	1.197	7.614	0.737	8.552	11.900
1996	2.375	4.557	2.792	5.095	9.232	3.862	0.733	5.974	10.246
Females									
1971	5.909	11.396	8.685	4.665	18.448	15.678	0.549	19.382	26.763
1986	4.155	6.288	7.832	6.391	11.782	12.581	0.919	14.064	16.893
1991	3.446	10.240	1.609	7.661	5.785	9.279	0.665	13.819	13.584
1996	2.787	7.501	7.274	1.315	4.460	7.219	0.900	10.410	11.915
Osteomyelitis and periostitis (0-74)									
Males									
1971	0.924	0.005	0.005	2.206	3.548	1.921	.	1.921	4.952
1986	0.885	2.240	3.705	0.004	1.918	0.004	.	2.240	4.128
1991	0.352	1.238	0.004	0.004	1.455	0.004	.	1.238	1.622
1996	0.399	0.004	0.004	1.475	0.004	1.263	.	1.263	1.880
Females									
1971	1.472	0.005	0.005	0.005	1.835	7.466	.	7.466	6.215
1986	0.191	0.004	0.004	0.004	0.805	0.005	.	0.006	1.309
1991	0.215	0.004	1.235	0.004	0.004	0.005	.	0.006	1.309
1996	0.332	0.004	0.004	1.228	0.908	0.004	.	0.006	1.781
Malignant neoplasm of the tracha, bronchus and lung (0-74)									
Males									
1971	21.509	47.111	43.169	46.212	49.411	50.877	0.074	69.339	118.260
1986	13.898	34.290	37.188	38.741	40.534	48.020	0.060	59.006	83.010
1991	16.010	31.893	31.685	33.693	37.656	44.070	0.056	54.400	72.603
1996	13.898	26.420	29.514	30.109	31.869	37.849	0.055	46.158	57.400
Females									
1971	10.672	23.096	23.826	18.793	27.979	25.312	0.177	34.265	54.047
1986	12.876	26.931	28.638	28.355	27.975	31.670	0.093	41.573	62.480
1991	12.601	27.579	28.001	26.347	28.818	30.804	0.080	41.346	62.516
1996	12.579	25.769	28.421	27.571	28.529	30.650	0.072	40.044	55.629
Malignant neoplasm of the skin [non melanoma] (0-74)									
Males									
1971	1.889	2.891	4.789	5.109	4.432	3.242	1.163	4.343	11.950
1986	1.309	2.813	1.229	1.044	3.265	4.999	0.732	5.736	5.969
1991	1.541	3.432	2.222	2.858	4.119	4.344	0.845	5.536	7.585
1996	1.608	3.343	3.671	3.946	3.901	3.288	0.658	4.689	6.161
Females									
1971	1.794	4.175	0.005	3.117	5.215	3.736	0.841	5.603	10.122
1986	0.715	2.699	1.163	0.004	2.082	0.715	1.225	2.792	3.903
1991	0.862	0.004	1.483	1.402	1.906	3.525	.	3.525	4.396
1996	0.862	2.573	2.520	1.179	1.082	1.872	0.914	3.182	4.003

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, lnRR: natural logarithm of the rate ratio, RD: rate difference

Table D.2: Standard errors of age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1
Year	QT	Q1	Q2	Q3	Q4	Q5	lnRR	RD	RD
Malignant neoplasm of the female breast (25-74)									
Females									
1971	20.691	49.645	46.078	44.664	45.596	46.264	0.095	67.860	99.705
1986	17.153	39.908	38.716	37.037	38.065	38.949	0.080	55.765	75.717
1991	14.905	35.304	35.415	31.480	29.267	35.580	0.078	50.123	66.543
1996	13.628	31.044	29.153	29.676	30.974	32.044	0.074	44.615	56.653
Malignant neoplasm of the cervix uteri (15-74)									
Females									
1971	11.122	16.916	19.416	25.052	27.555	32.750	0.236	36.861	49.631
1986	6.054	9.920	13.515	13.097	14.667	16.930	0.270	19.622	27.197
1991	5.569	10.827	11.209	12.179	11.045	17.370	0.238	20.468	23.566
1996	4.865	9.677	11.748	12.007	9.376	12.398	0.258	15.728	20.253
Malignant neoplasm of the uterus [except cervix uteri] (15-74)									
Females									
1971	6.208	10.336	13.777	13.216	13.719	16.964	0.330	19.865	34.788
1986	3.926	8.739	8.887	8.699	7.865	9.419	0.264	12.848	20.682
1991	3.869	7.910	9.527	8.042	8.816	9.058	0.263	12.026	19.448
1996	3.283	6.673	7.796	6.631	7.314	8.097	0.262	10.493	15.189
Malignant neoplasm of the testis (0-74)									
Males									
1971	5.637	9.552	18.212	9.404	13.145	11.574	0.657	15.007	26.744
1986	2.939	5.735	7.161	5.184	5.433	7.157	0.659	9.171	15.040
1991	2.344	4.907	6.008	6.239	2.783	5.699	0.730	7.521	11.117
1996	2.254	5.212	0.857	6.587	5.447	5.735	0.825	7.749	10.447
Hodgkin's disease (0-74)									
Males									
1971	8.198	19.858	19.692	18.862	18.300	15.443	0.348	25.156	38.837
1986	4.030	8.393	9.430	9.797	9.631	8.150	0.496	11.699	19.554
1991	3.350	6.661	8.926	4.418	8.638	9.531	0.539	11.628	15.319
1996	2.746	9.607	7.715	5.331	5.209	4.064	0.562	10.432	12.738
Females									
1971	6.298	14.771	10.521	14.901	13.605	14.920	0.409	20.995	28.849
1986	3.127	8.534	5.725	7.572	5.498	7.601	0.603	11.429	14.193
1991	3.216	8.320	5.926	5.237	7.182	9.075	0.525	12.312	13.733
1996	2.326	7.851	5.572	5.646	4.609	3.818	0.780	8.731	11.787
Leukaemia (0-74)									
Males									
1971	7.473	17.178	12.791	14.087	19.905	17.581	0.408	24.580	28.675
1986	5.094	8.933	12.911	13.892	7.682	11.478	0.709	14.545	17.883
1991	4.324	6.697	12.655	8.786	11.182	8.276	0.913	10.646	13.917
1996	3.913	8.009	11.243	6.062	4.814	10.973	0.635	13.585	13.000
Females									
1971	7.768	17.169	14.484	11.130	17.210	24.574	0.382	29.978	29.558
1986	5.297	11.328	11.713	9.549	12.540	14.190	0.634	18.157	18.962
1991	3.952	5.646	8.206	8.781	11.104	10.992	0.914	12.357	13.250
1996	4.038	6.898	6.818	9.542	11.936	10.412	0.766	12.490	14.006
Diseases of the thyroid (0-74)									
Males									
1971	2.254	3.579	6.146	4.324	4.389	6.012	1.307	6.997	9.873
1986	1.125	2.240	0.004	1.323	4.273	2.589	1.226	3.423	5.544
1991	0.223	0.004	0.004	1.034	0.004	0.004	.	0.006	1.172
1996	0.820	0.004	1.451	0.004	3.280	0.750	.	0.750	4.642
Females									
1971	2.332	7.407	4.073	3.112	3.644	5.195	0.711	9.047	12.577
1986	0.739	0.004	2.635	0.004	1.864	1.733	.	1.733	4.282
1991	0.640	0.004	1.483	2.143	0.904	1.173	.	1.173	3.640
1996	0.797	0.004	0.004	0.681	1.574	3.686	.	3.686	3.395

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, lnRR: natural logarithm of the rate ratio, RD: rate difference

Table D.2: Standard errors of age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1
Year	QT	Q1	Q2	Q3	Q4	Q5	lnRR	RD	RD
Diabetes mellitus (0-49)									
Males									
1971	6.543	11.525	13.671	16.781	13.501	15.166	0.420	19.049	27.380
1986	4.685	6.787	11.816	10.169	9.799	12.749	0.461	14.443	17.966
1991	4.188	6.989	8.825	8.682	10.143	13.077	0.455	14.828	16.947
1996	3.787	6.959	6.620	6.214	9.790	10.509	0.452	12.604	17.013
Females									
1971	6.563	8.333	5.992	15.809	17.682	21.884	0.650	23.417	25.388
1986	3.460	5.353	7.348	6.742	8.635	10.720	0.805	11.982	14.967
1991	3.074	4.714	5.653	6.667	8.558	9.947	0.586	11.007	11.737
1996	2.922	8.114	5.908	4.050	6.376	10.035	0.557	12.904	12.105
Deficiency anaemia (0-74)									
Males									
1971	0.932	0.005	0.005	0.005	3.117	3.015	.	3.015	4.812
1986	0.002	0.004	0.004	0.004	0.004	0.004	.	0.006	0.000
1991	0.002	0.004	0.004	0.004	0.004	0.004	.	0.006	0.000
1996	0.002	0.004	0.004	0.004	0.004	0.004	.	0.006	0.000
Females									
1971	0.907	0.005	1.939	3.112	2.135	1.158	.	1.158	5.623
1986	0.002	0.004	0.004	0.004	0.005	0.005	.	0.006	0.000
1991	0.002	0.004	0.004	0.004	0.004	0.005	.	0.006	0.000
1996	0.825	1.571	0.004	0.004	0.004	3.009	1.414	3.395	4.315
Epilepsy (0-74)									
Males									
1971	6.225	10.556	11.896	14.114	13.256	17.032	0.500	20.038	27.780
1986	4.808	10.842	9.029	8.298	11.950	12.333	0.394	16.422	22.411
1991	3.686	4.655	8.245	7.696	8.780	11.726	0.524	12.617	16.221
1996	3.777	6.104	8.295	10.391	9.976	8.364	0.696	10.354	16.891
Females									
1971	5.106	8.225	6.228	10.102	11.263	19.124	0.650	20.818	22.326
1986	4.185	9.365	10.513	8.203	7.866	10.403	0.517	13.997	18.933
1991	3.432	5.537	6.350	7.123	8.401	10.651	0.576	12.004	14.439
1996	3.309	9.192	9.554	3.097	3.880	9.705	0.489	13.367	15.363
Active rheumatic fever (0-74)									
Males									
1971	1.520	0.005	5.880	4.598	0.005	0.005	.	0.006	7.294
1986	0.002	0.004	0.004	0.004	0.004	0.004	.	0.006	0.000
1991	0.628	0.004	0.004	0.004	0.004	2.383	.	2.383	3.951
1996	0.002	0.004	0.004	0.004	0.004	0.004	.	0.006	0.000
Females									
1971	1.295	0.005	4.657	3.244	0.005	2.534	.	2.534	5.924
1986	0.002	0.004	0.004	0.004	0.005	0.005	.	0.006	0.000
1991	0.620	2.043	0.004	0.004	0.004	2.102	1.414	2.931	2.212
1996	0.766	0.004	0.004	0.004	0.004	0.004	.	0.006	4.126
Chronic rheumatic heart disease (0-74)									
Males									
1971	9.308	18.141	20.284	18.553	23.145	23.049	0.216	29.331	44.434
1986	3.151	5.137	6.326	6.724	6.941	10.164	0.394	11.389	13.450
1991	2.136	4.576	3.523	4.562	4.064	6.118	0.541	7.640	9.812
1996	2.120	3.292	5.130	3.031	4.775	6.411	0.521	7.206	9.547
Females									
1971	9.775	19.744	18.644	23.668	22.157	26.755	0.206	33.252	49.122
1986	3.560	7.280	8.889	7.670	8.836	6.432	0.318	9.714	17.725
1991	2.437	3.767	5.994	5.355	4.962	6.581	0.472	7.583	12.843
1996	2.690	6.330	5.726	6.695	5.483	6.762	0.438	9.263	12.605
Hypertensive disease (35-74)									
Males									
1971	5.856	14.619	9.858	12.735	13.387	14.888	0.261	20.866	31.701
1986	3.571	6.856	7.345	6.856	8.100	9.833	0.301	11.987	16.764
1991	2.531	4.222	5.096	6.296	5.242	6.440	0.410	7.701	11.896
1996	2.726	5.159	5.162	5.460	5.917	8.236	0.288	9.718	11.321
Females									
1971	5.420	11.079	13.257	11.321	14.553	9.291	0.348	14.460	30.895
1986	2.950	5.927	5.712	6.935	5.733	7.908	0.337	9.882	16.407
1991	2.595	6.073	4.798	5.517	4.694	8.167	0.331	10.178	13.740
1996	1.892	4.521	2.486	3.485	4.652	5.485	0.361	7.108	9.155

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, lnRR: natural logarithm of the rate ratio, RD: rate difference

Table D.2: Standard errors of age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1
Year	**QT**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**lnRR**	**RD**	**RD**
Ischaemic heart disease (35-74)									
Males									
1971	45.845	103.476	97.337	102.165	99.023	107.480	0.034	149.195	246.520
1986	28.332	57.032	59.338	60.668	67.194	71.843	0.038	91.728	129.067
1991	22.131	44.459	47.846	47.950	50.096	58.344	0.041	73.353	99.144
1996	19.001	36.870	39.212	42.079	43.956	50.130	0.041	62.228	77.272
Females									
1971	26.131	61.563	56.190	56.128	55.738	62.530	0.059	87.749	158.636
1986	15.812	34.775	33.667	34.194	33.819	39.110	0.062	52.334	87.735
1991	13.015	27.662	27.250	26.768	29.042	34.687	0.068	44.366	71.454
1996	11.276	21.775	23.480	23.722	24.541	31.595	0.070	38.372	53.745
Cerebrovascular diseases (35-74)									
Males									
1971	17.928	42.421	37.234	39.756	40.319	40.427	0.086	58.600	101.083
1986	10.669	20.271	22.891	21.762	23.243	29.960	0.102	36.173	49.150
1991	8.826	17.243	18.076	18.612	19.639	25.177	0.104	30.515	39.832
1996	7.576	13.360	16.432	15.855	17.384	21.496	0.105	25.310	31.347
Females									
1971	17.063	40.840	36.384	40.200	34.988	39.915	0.097	57.106	94.884
1986	10.082	21.801	22.719	21.233	22.344	23.464	0.109	32.029	50.396
1991	8.354	18.889	17.748	16.875	17.831	22.544	0.113	29.411	41.788
1996	7.448	15.189	16.859	15.725	16.249	19.313	0.114	24.570	33.464
Acute respiratory infections [except influenza] (0-74)									
Males									
1971	2.593	5.597	5.510	9.719	0.003	0.003	.	5.597	10.266
1986	0.001	0.002	0.003	0.003	0.003	0.003	.	0.004	0.000
1991	1.643	4.163	4.449	4.846	0.003	0.003	.	4.163	5.727
1996	0.885	0.002	0.002	0.002	0.003	4.519	.	4.519	3.251
Females									
1971	3.132	6.258	0.003	10.686	9.812	0.003	.	6.258	12.512
1986	1.156	0.003	0.003	5.807	0.003	0.003	.	0.004	4.348
1991	1.803	0.003	6.785	0.003	0.003	5.840	.	5.840	6.197
1996	1.363	3.868	4.821	0.003	0.003	0.003	.	3.868	4.650
Influenza (0-74)									
Males									
1971	3.685	11.020	8.123	4.520	10.435	6.477	0.654	12.783	18.744
1986	0.742	2.090	0.004	0.004	3.572	0.906	1.225	2.279	3.197
1991	0.488	0.004	1.204	1.746	0.004	1.040	.	1.040	2.544
1996	0.876	1.132	0.004	0.004	0.004	5.116	1.414	5.240	2.898
Females									
1971	4.207	2.607	8.826	11.290	9.857	11.462	1.062	11.755	20.013
1986	1.212	0.004	2.407	2.697	4.800	1.433	.	1.433	5.847
1991	0.563	1.760	0.004	0.004	0.004	2.303	1.134	2.898	3.121
1996	0.462	1.559	2.047	0.004	0.004	0.004	.	1.559	2.303
Pneumonia (0-74)									
Males									
1971	16.923	30.332	35.966	33.096	38.075	45.879	0.163	54.999	82.314
1986	7.710	11.498	16.151	14.546	19.356	23.053	0.190	25.761	34.697
1991	6.270	10.017	12.403	13.853	14.218	18.870	0.232	21.363	27.629
1996	6.324	13.729	10.783	14.218	12.940	19.226	0.191	23.624	26.851
Females									
1971	15.967	28.699	27.073	34.885	39.335	43.308	0.210	51.954	74.585
1986	6.804	9.216	10.736	10.868	18.651	23.506	0.236	25.249	31.423
1991	5.486	9.084	9.194	14.650	12.675	15.293	0.231	17.787	25.558
1996	5.399	13.102	9.102	10.853	10.873	15.313	0.271	20.153	23.189

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, lnRR: natural logarithm of the rate ratio, RD: rate difference

Table D.2: Standard errors of age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1
Year	QT	Q1	Q2	Q3	Q4	Q5	lnRR	RD	RD
Bronchitis (0-74)									
Males									
1971	1.699	8.219	0.005	3.695	0.005	2.497	0.846	8.590	9.611
1986	1.221	0.004	3.795	0.004	1.788	3.869	.	3.869	6.289
1991	0.763	0.004	0.004	1.713	1.970	2.448	.	2.448	3.871
1996	0.358	0.901	0.004	0.004	0.004	1.887	1.256	2.092	1.404
Females									
1971	2.983	10.320	0.005	5.210	0.005	10.074	0.789	14.421	13.412
1986	0.590	1.485	0.004	1.321	2.020	1.065	1.414	1.827	3.277
1991	1.161	1.507	1.609	0.992	3.258	3.231	1.201	3.565	6.706
1996	1.169	0.004	0.004	5.852	0.908	0.620	.	0.620	5.091
Emphysema (0-74)									
Males									
1971	8.563	17.336	15.728	19.034	18.628	21.996	0.197	28.006	50.103
1986	4.003	6.869	6.877	8.103	10.741	11.161	0.267	13.105	19.659
1991	3.370	5.963	6.461	7.269	7.497	9.564	0.256	11.270	16.520
1996	2.631	5.150	5.396	5.617	5.857	7.460	0.275	9.065	11.236
Females									
1971	3.873	7.701	9.556	8.961	6.918	10.169	0.474	12.756	21.738
1986	2.565	5.780	4.812	4.877	7.243	5.189	0.342	7.768	15.191
1991	2.396	5.545	3.507	5.711	5.457	5.926	0.374	8.116	13.306
1996	2.231	4.814	4.678	5.785	5.530	4.034	0.343	6.281	11.056
Asthma (0-49)									
Males									
1971	3.149	9.496	6.202	5.968	4.788	8.830	0.776	12.967	12.698
1986	4.481	4.684	11.986	9.782	10.170	11.626	0.800	12.534	18.380
1991	3.055	0.004	9.036	4.876	9.740	7.799	.	7.799	12.851
1996	2.434	8.728	0.004	5.763	6.127	4.398	0.621	9.773	10.205
Females									
1971	3.478	6.323	6.393	6.565	6.700	11.208	0.825	12.868	14.398
1986	3.170	7.208	9.339	5.156	7.305	4.686	0.887	8.597	12.600
1991	3.446	7.863	7.058	9.315	7.098	8.726	0.669	11.746	14.622
1996	3.042	6.228	7.905	8.119	7.879	4.703	0.766	7.805	12.532
Gastric and duodenal [peptic] ulcer (0-74)									
Males									
1971	7.422	12.811	13.484	14.751	16.840	20.991	0.260	24.591	40.467
1986	3.346	4.526	5.870	5.517	9.161	10.168	0.386	11.130	15.646
1991	2.486	4.033	5.446	3.905	6.128	7.662	0.403	8.658	11.075
1996	2.019	3.215	2.827	5.721	5.058	5.635	0.411	6.488	8.136
Females									
1971	4.196	9.142	11.642	6.276	5.928	11.326	0.409	14.555	22.546
1986	3.008	5.413	6.007	6.205	7.147	9.546	0.421	10.974	14.044
1991	1.928	3.148	5.972	3.334	4.031	4.782	0.623	5.725	10.430
1996	1.660	2.473	4.570	2.969	3.430	4.778	0.619	5.380	7.096
Appendicitis (0-74)									
Males									
1971	2.376	2.702	7.448	3.327	6.815	5.686	1.147	6.295	11.881
1986	1.120	2.318	0.004	3.307	1.788	4.018	0.930	4.639	4.779
1991	1.221	3.201	0.004	3.933	1.548	2.863	1.250	4.294	5.138
1996	0.690	1.312	2.019	0.760	2.289	0.004	.	1.312	2.416
Females									
1971	2.744	8.204	0.005	8.781	5.425	3.723	0.959	9.009	13.068
1986	1.277	1.485	2.350	0.004	6.269	1.065	1.414	1.827	5.297
1991	0.509	0.004	0.004	2.143	0.004	0.946	.	0.946	2.813
1996	1.245	0.004	1.948	5.620	1.712	1.324	.	1.324	5.393

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, lnRR: natural logarithm of the rate ratio, RD: rate difference

Table D.2: Standard errors of age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1
Year	QT	Q1	Q2	Q3	Q4	Q5	lnRR	RD	RD
Abdominal hernia (0-74)									
Males									
1971	5.402	13.982	10.008	9.547	9.545	15.933	0.536	21.198	26.251
1986	2.264	0.004	0.004	5.563	8.133	5.748	.	5.748	9.530
1991	0.926	2.034	2.012	2.530	1.771	1.840	0.917	2.743	4.510
1996	1.577	2.235	2.128	4.749	5.265	2.077	0.651	3.051	6.468
Females									
1971	3.979	3.266	12.844	9.420	8.131	7.188	1.134	7.896	19.797
1986	0.980	3.600	2.165	2.026	0.005	1.505	0.925	3.902	4.862
1991	0.547	1.859	1.694	0.779	0.692	1.276	1.225	2.255	3.187
1996	0.846	0.942	1.442	1.633	3.327	1.156	1.235	1.491	3.827
Ilieus without hernia (0-74)									
Males									
1971	3.021	2.455	6.174	5.550	6.103	10.070	1.061	10.365	15.111
1986	2.119	5.855	4.546	4.210	0.004	3.637	0.794	6.893	9.575
1991	2.004	5.324	4.717	3.091	5.688	3.856	0.718	6.574	8.087
1996	1.743	0.004	0.857	2.388	4.393	6.617	.	6.617	7.983
Females									
1971	4.796	7.086	11.694	10.226	12.537	11.425	0.509	13.444	23.898
1986	2.187	4.179	4.351	4.944	2.859	7.513	0.726	8.597	10.207
1991	1.548	3.791	2.554	1.854	5.334	3.296	0.667	5.023	7.379
1996	1.282	3.379	1.442	1.800	2.851	4.031	0.597	5.259	5.466
Cirrhosis of the liver (0-74)									
Males									
1971	15.153	23.659	24.667	31.598	34.553	46.857	0.144	52.491	69.316
1986	10.318	18.728	16.356	24.248	22.044	32.158	0.122	37.214	43.910
1991	8.756	13.826	16.413	18.038	19.809	28.939	0.127	32.072	37.284
1996	7.539	11.734	14.318	15.514	18.322	23.472	0.126	26.242	29.936
Females									
1971	11.594	21.380	22.751	25.524	21.978	35.904	0.194	41.787	54.114
1986	7.148	13.402	15.195	14.374	16.381	20.411	0.189	24.418	32.817
1991	6.189	11.180	13.594	11.118	12.625	20.518	0.210	23.366	28.588
1996	4.898	9.562	9.846	12.125	10.768	12.221	0.209	15.517	21.302
Cholethiasis, Cholecystitis, and Cholangitis (0-74)									
Males									
1971	4.101	9.160	6.073	12.391	6.991	8.675	0.429	12.616	21.599
1986	1.653	3.555	3.113	2.781	3.277	5.075	0.545	6.196	8.135
1991	1.441	3.898	2.345	2.346	1.871	4.332	0.635	5.828	6.631
1996	1.365	3.481	2.343	3.557	3.260	2.455	0.642	4.260	5.606
Females									
1971	4.559	10.688	8.005	7.985	11.639	11.727	0.448	15.867	23.307
1986	1.195	4.619	2.165	1.247	1.394	3.592	0.534	5.852	6.869
1991	1.105	3.229	0.004	2.339	1.139	4.200	0.626	5.297	5.903
1996	1.629	2.897	1.442	2.741	2.272	7.330	0.664	7.882	6.686
Nephritis and nephrosis (0-74)									
Males									
1971	7.219	13.108	14.478	13.086	13.479	23.431	0.324	26.848	33.898
1986	5.396	8.168	13.044	9.066	12.318	15.738	0.264	17.731	25.239
1991	4.153	5.489	10.178	8.624	10.734	10.473	0.292	11.825	19.640
1996	4.161	8.777	6.665	8.344	10.709	11.885	0.219	14.775	17.619
Females									
1971	5.654	13.334	10.022	12.111	10.622	15.826	0.388	20.694	28.512
1986	4.572	7.153	7.284	14.328	9.974	10.358	0.331	12.588	22.199
1991	3.815	7.510	9.592	6.191	7.634	11.348	0.268	13.608	19.583
1996	4.201	11.689	9.729	5.758	6.666	12.089	0.281	16.816	18.914

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, lnRR: natural logarithm of the rate ratio, RD: rate difference

Table D.2: Standard errors of age-standardized 'avoidable' period expected years of life lost per 100,000 population, by cause of death (age range in parentheses), by sex, by neighbourhood income quintile, urban Canada, 1971 to 1996 (continued)

							Q5-Q1		QT-Q1
Year	QT	Q1	Q2	Q3	Q4	Q5	lnRR	RD	RD
Infections of the urinary system (0-74)									
Males									
1971	4.694	12.779	6.247	11.057	10.332	9.808	0.403	16.109	24.502
1986	1.072	1.683	2.426	3.724	0.004	2.612	1.119	3.107	5.189
1991	1.558	3.416	1.074	1.677	0.004	6.291	1.097	7.159	5.863
1996	0.341	1.561	0.004	0.004	0.004	1.016	1.155	1.862	1.601
Females									
1971	4.158	9.210	6.344	10.146	9.775	9.425	0.509	13.178	22.427
1986	1.503	4.016	3.709	1.247	3.393	2.829	0.814	4.913	7.575
1991	1.678	2.539	1.609	0.779	2.130	8.298	0.824	8.678	7.068
1996	1.306	1.949	1.453	3.126	5.538	1.644	1.006	2.550	4.951
Hyperplasia of the prostate (0-74)									
Males									
1971	2.050	4.362	3.904	4.716	3.840	4.680	0.771	6.398	12.889
1986	0.786	0.004	0.004	1.983	2.545	1.770	.	1.770	4.082
1991	0.192	0.004	0.004	0.894	0.004	0.004	.	0.006	1.063
1996	0.221	0.004	0.857	0.004	0.004	0.750	.	0.750	1.076
Maternal mortality [complications of pregnancy] (0-74)									
Females									
1971	4.817	10.699	5.629	10.137	10.938	14.723	0.682	18.200	21.073
1986	2.137	5.768	4.200	0.004	0.005	7.959	0.772	9.829	8.594
1991	1.528	5.427	0.004	0.004	5.928	0.005	.	5.427	7.228
1996	1.787	3.831	5.562	2.459	2.341	4.954	0.921	6.262	7.647
Congenital cardiovascular anomalies (0-74)									
Males									
1971	16.353	30.490	34.728	34.203	38.916	40.255	0.243	50.499	74.496
1986	13.306	25.782	24.939	31.844	32.006	33.500	0.250	42.273	54.386
1991	10.938	21.788	25.817	23.901	24.555	25.890	0.262	33.838	43.180
1996	9.534	18.341	22.622	19.813	21.063	24.789	0.302	30.836	39.872
Females									
1971	16.288	36.428	31.354	38.429	37.052	37.747	0.246	52.458	74.064
1986	14.154	29.805	30.300	30.026	33.151	34.620	0.248	45.682	57.750
1991	10.467	19.700	26.406	22.497	24.284	24.504	0.319	31.441	41.991
1996	9.283	22.285	17.439	18.276	24.252	20.839	0.304	30.511	38.530
Congenital digestive anomalies (0-74)									
Males									
1971	7.105	16.649	19.241	15.590	13.256	14.436	0.577	22.036	32.888
1986	2.143	5.377	0.004	7.546	0.004	5.329	1.414	7.570	8.369
1991	2.120	4.663	0.004	6.898	6.792	0.004	.	4.663	8.315
1996	1.735	0.901	1.270	7.140	0.004	4.408	1.414	4.499	7.415
Females									
1971	6.589	13.038	13.595	12.925	16.010	15.963	0.696	20.611	30.470
1986	3.578	8.265	0.004	10.204	8.865	8.931	0.866	12.169	14.059
1991	2.107	7.452	0.004	5.337	5.358	0.005	.	7.452	8.456
1996	2.746	7.110	5.732	7.948	6.613	0.976	1.227	7.177	11.574
Perinatal mortality									
Males									
1971	36.891	70.750	77.181	82.314	83.169	90.573	0.115	114.930	172.783
1986	22.458	43.945	43.878	51.786	51.222	57.000	0.153	71.973	91.569
1991	17.146	34.944	34.042	35.698	42.623	43.276	0.170	55.623	69.110
1996	18.275	32.139	44.433	42.285	37.057	44.661	0.186	55.023	77.775
Females									
1971	33.493	68.002	65.742	74.230	73.422	85.861	0.133	109.528	157.000
1986	20.166	39.951	40.628	43.194	47.849	51.658	0.189	65.304	83.503
1991	16.391	34.200	32.611	33.301	38.220	43.858	0.192	55.616	66.030
1996	17.124	33.644	36.986	39.890	39.641	39.990	0.204	52.260	71.695
Motor vehicle accidents (0-74)									
Males									
1971	32.754	69.608	73.560	75.722	74.410	70.665	0.092	99.191	152.529
1986	21.589	51.468	48.867	47.034	47.681	46.874	0.102	69.614	97.254
1991	18.723	44.827	43.875	38.746	43.555	41.564	0.107	61.131	85.333
1996	15.866	42.078	40.666	33.539	32.932	28.055	0.129	50.573	71.376
Females									
1971	21.992	48.327	43.857	53.863	53.317	44.688	0.147	65.822	98.430
1986	14.750	38.658	29.537	30.098	29.447	34.406	0.151	51.751	65.049
1991	12.573	29.928	30.316	28.291	27.691	27.919	0.172	40.929	54.401
1996	10.846	23.313	26.153	22.102	23.850	24.252	0.202	33.640	45.957

Abbreviations: QT: total population, Q1: richest quintile, Q5: poorest quintile, Q5-Q1: poorest quintile-richest quintile comparison, QT-Q1: total population-richest quintile comparison, lnRR: natural logarithm of the rate ratio, RD: rate difference