Burden of cardiovascular disease in Canada

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BACKGROUND: This report updates the death estimates for cardiovascular disease (CVD) in Canada and introduces a population-based perspective on disease prevalence and health-related quality of life (HRQOL) burden.

METHODS: The Canadian Mortality Database was used to estimate the mortality of men and women in different age groups for the 139 Canadian health regions from 1950 to 1999. Heart disease prevalence and its impact on HRQOL were estimated using the 2000–2001 Canadian Community Health Survey (CCHS). Life table techniques were used to estimate the impact of heart disease on life and health expectancy.

RESULTS: Although CVD remains the leading cause of death in Canada, between 1950 and 1999 the death rates from CVD dropped from 702 per 100,000 to 288 per 100,000 men, and from 562 per 100,000 to 175 per 100,000 women. Results from the CCHS indicated that 5.4% of men and 4.6% of women reported having heart disease as diagnosed by a medical professional. Of these individuals, 14% of men and 21% of women reported difficulty ambulating – about six times more than people without heart disease. In total, 4.5 years of life expectancy and 2.8 years of health expectancy were lost due to CVD. The study also found large differences in the burden of CVD among men and women and across the 139 Canadian health regions.

CONCLUSIONS: CVD is a major disease burden in terms of both mortality and HRQOL and is an important source of health inequalities between populations in Canada. Any attempt to improve the health of Canadians or to reduce health inequalities should include interventions to reduce CVD mortality and morbidity. Given the present impact of CVD on HRQOL, reducing or eliminating heart disease may potentially result in an increase in life expectancy that will be larger than the gains in health expectancy.

Key Words: Health outcomes; Life expectancy; Morbidity; Mortality; Population health; Quality of life
prevalence of CVD risk factors such as cigarette smoking (4-7) and improvements in survival due to improved medical care (7-9). The decrease in CVD mortality has helped Canadians experience large increases in life expectancy over the latter half of the 20th century. Nevertheless, longer life has been described as an empty prize if these added years are lived in poor health (10). To more completely assess the burden of heart disease, we should not only determine how many people die from the disease, but also monitor how many people live with it and the extent to which it affects their health-related quality of life (HRQOL).

In the present paper, we have updated previous estimates on the burden of CVD in Canada using the most recent mortality data available, reported national estimates of self-reported heart disease prevalence, estimated the HRQOL of those living with and without heart disease, and measured the impact of heart disease on both life and health expectancy in Canada. Health expectancy is a relatively new summary measure of population health that combines mortality and morbidity into a single indicator (11,12).

METHODS

Data sources

The Canadian mortality database was used to calculate age-specific death rates, survival probabilities and life tables. Cross-sectional data on health status and chronic conditions were derived from the Canadian Community Health Survey (CCHS) Cycle 1.1 conducted by Statistics Canada (13,14). This survey provides cross-sectional estimates of health determinants, health status and health system use at a subprovincial level (health region or combination of health regions). The target population of the CCHS included household residents in all provinces and territories, with the principal exclusion of populations on Indian reserves, Canadian Forces’ bases and some remote areas. There was one randomly selected respondent per household, although planned oversampling of youths resulted in a second member of certain households being interviewed. For the first collection cycle, only those 12 years of age and older were eligible for selection. The CCHS Cycle 1.1 began data collection in September 2000 and the total sample size was 131,535 household respondents, representing a response rate of 84.7%.

Variable definitions and classifications

Disease groups: Disease groups for mortality statistics were defined for the most responsible underlying condition on the death certificate using codes from the eighth and ninth revisions of the International Classification of Diseases (ICD-8 and ICD-9, respectively) (see Appendix A). Heart disease prevalence was estimated using the 2000/01 CCHS response for self-reported chronic conditions. Respondents were asked if they had been diagnosed by a health professional with any of 26 chronic conditions. Respondents who reported that they had heart disease were further asked whether they had a previous heart attack, angina and/or heart failure.

HRQOL measures: HRQOL describes a person’s own perceived mental and physical health. The International Classification of Functioning, Disability and Health was used as a framework for selecting HRQOL measures (15). Indicators from the CCHS were selected to represent the overlapping domains of functioning, limitations in activity and participation in society. More detailed descriptions of these indicators can be found elsewhere (16,17). Health-adjusted life expectancy (HALE) is a polychotomous measure that incorporates a utility-based HRQOL measure to combine discrete health states into a single indicator, indicating the expectation of equivalent years of good health. The health utilities index (HUI) mark III was the HRQOL measure used to estimate a person’s functional ability and HALE (18).

Measures of functional restrictions: Ambulatory restrictions were measured in terms of an inability to walk around the neighbourhood or an ability to walk with difficulty, requiring the help of others or mechanical supports such as braces, a cane, crutches or a wheelchair. The proportion of people who usually live with pain and the proportion of people who are not happy or not interested in life were also estimated.

Measures of restrictions in activities: Disability days were defined as the number of days in the two weeks prior during which the respondent stayed in bed or cut down in their activities because of illness or injury. The need for help (activity dependence), for health reasons, with instrumental activities of daily living (IADL) or basic activities of daily living (ADL) was also measured. IADLs refer to activities that relate to living independently, including preparing meals, shopping for groceries or other necessities, doing everyday housework and doing heavy household chores (eg, washing walls, yard work). ADLs refer to activities of personal care (eg, washing, dressing or eating, or moving about inside the house).

Measure of participation in society: Participation in society was measured in terms of whether a person was unemployed due to illness or disability.

Analyses

Calculation of mortality and prevalence rates: Age- and sex-specific mortality rates for the various disease/condition groups were calculated using mortality data and postcensal population estimates from Statistics Canada. To allow comparison over time and across regions, all estimates were standardized using the direct method and the 1991 Canadian population.

Life table analysis: Life expectancy is the average length of life that a person would be expected to live, given the current mortality rates in the population. Period life tables for men and women were calculated using an adaptation of Chiang’s method (19). Cause-deleted life expectancy and related measures were estimated by subtracting cardiovascular deaths from overall mortality rate (20). The regional cause-deleted life expectancies were divided by the overall Canadian estimate, and the ratios were mapped using colours based on five fixed ratio categories first used by the Dartmouth Atlas of Cardiovascular Health Care in the United States (21). HALE was calculated using a modification of the Sullivan method (22). Sullivan used a period life table and the prevalence of disability to estimate the number of life years lived free of disability. After calculating life tables for each group, HALE was estimated by weighting the years of life lived according to the mean HUI values by age and sex for each population. Heart disease-deleted mean HUI values were used to calculate HALE if heart disease was eliminated.

Statistical testing: Coefficients of variation (CV) and 95% confidence intervals were calculated using a bootstrap method. Estimates with a CV between 16.7 and 33.3 should be interpreted with caution due to high sampling variation. Estimates with a CV greater than 33.4 were not reported.

RESULTS

Mortality due to CVD

In Canada, age-standardized death rates from CVD have decreased substantially since the middle of the century (Figure 1). Men have a much higher mortality rate than do women, but the difference has been narrowing in recent
years. Between 1950 and 1969, the death rate for women declined by 149 deaths per 100,000 per year (562 per 100,000 to 413 per 100,000) – about two and a half times faster than for men (702 to 644 per 100,000). Over the next 20 years (1970 to 1989), mortality rates dropped by over 45% for both men and women. The most current CVD mortality rate for men was about 1.6 times higher than for women (288 per 100,000 versus 175 per 100,000).

Over the past 50 years, the largest drop in absolute mortality rate in men occurred among the oldest age group (85 years and older), which declined between 1950 and 1999 by 6136 deaths per 100,000 men per year to 7725 deaths per 100,000 men per year (Figure 2). At younger ages, there were much fewer deaths (98 per 100,000 in those aged 35 to 44 years in 1950), but the 73% drop in death rate was dramatic. In women, the death rate decreased in these age groups by about 80% (Figure 3). Figures 4 and 5 show the effect of the changing age of death from CVD in terms of the increase in life expectancy. As the drop in mortality rates has slowed down for women over the past 20 years, there has been a smaller gain in life expectancy. Similarly, now that the mortality...
The disease prevalence ratio of people who reported a similar prevalence of angina (1.8% of men and 1.9% of women) was smaller than the death rate ratio (1.6:1). Men and women had a male to female ratio of heart disease prevalence (1.2:1) was did women (5.4% of men and 4.6% of women); however, the disease prevalence ratio of people who reported living with heart disease somewhat more often than heart disease was present in all domains of function, activity, and participation. Similar to other chronic diseases, heart disease was reported with more HRQOL limitations in women than in men. HRQOL limitations for people with heart disease were much more increased with age, similar to most chronic conditions.

Prevalence of CVD
Table 1 and Figures 8 and 9 show heart disease prevalence in Canada. These estimates are the percentage of community-dwelling people in Canada who self-reported that they had heart disease at the time of the 2000/01 CCHS. Overall, men reported living with heart disease somewhat more often than did women (5.4% of men and 4.6% of women); however, the male to female ratio of heart disease prevalence (1.2:1) was smaller than the death rate ratio (1.6:1). Men and women had a similar prevalence of angina (1.8% of men and 1.9% of women). The disease prevalence ratio of people who reported a previous heart attack was higher for men than for women (2.7% of men versus 1.5% of women). Similar to most chronic diseases, heart disease increased with age, with 25% of people age 80 years or older reporting that they had heart disease. Figures 8 and 9 suggest that heart disease becomes increasingly complex and severe with increasing age. In the 40- to 49-year age group, 19% of people with heart disease reported that they had at least two of angina, previous heart attack or congestive heart failure. This proportion increased to 35% of those people over the age of 80 years.

HRQOL
Figures 10 and 11 demonstrate that limitations in HRQOL increased with age, similar to most chronic conditions. Table 1 shows that people with heart disease were much more likely to report limitations in HRQOL than people without heart disease or with no chronic conditions. For instance, 14% of men and 21% of women with heart disease had difficulty ambulating; this was about six times more than people without heart disease (2.4% of men and 3.3% of women) and over 20 times more than people without chronic conditions (0.6% of men and women). There was generally a gradient in the HRQOL limitations caused by specific heart conditions: congestive heart failure was generally associated with the greatest HRQOL limitations, followed by angina with a previous heart attack. Similar to other chronic diseases, heart disease was reported with more HRQOL limitations in women than in men. HRQOL limitations for people with heart disease were present in all domains of function, activities and participation.

Given the present burden of disease, as shown in Figure 12, eliminating CVD will extend Canadian life expectancy by 3.5 years for men and 3.1 years for women, but the gains in HALE show that not all of this increase would be in a healthy state (3.0 years for men and 2.6 years for women).

Regional variation in CVD mortality
Figure 13 shows the difference in CVD mortality for health regions in Canada. Because CVD is the leading cause of death in Canada and because there are wide variations in death rates between Canadian health regions, it is not surprising that CVD mortality is one of the largest contributors to a previous heart attack was higher for men than for women (2.7% of men versus 1.5% of women). Similar to most chronic diseases, heart disease increased with age, with 25% of people age 80 years or older reporting that they had heart disease. Figures 8 and 9 suggest that heart disease becomes increasingly complex and severe with increasing age. In the 40- to 49-year age group, 19% of people with heart disease reported that they had at least two of angina, previous heart attack or congestive heart failure. This proportion increased to 35% of those people over the age of 80 years.

data from Statistics Canada
the observed differences in life expectancy among populations in Canada. Further analyses showed that eliminating CVD deaths reduced the gap in the average mortality rate of the lowest and highest health region quintiles from 277 per 100,000 population to 194 deaths per 100,000 population.

**DISCUSSION**

CVD was the leading cause of death in Canada in 1999. While improvements in CVD mortality rates have had an important contribution to the gains in life expectancy over the past 20 years, CVD remains the leading cause of life expectancy.
loss in Canada. The rate at which CVD death rates have been decreasing has begun to level off in the past 10 years. If this trend continues, future gains in life expectancy from improvements in CVD will become smaller. Furthermore, now that CVD death rates in the young and middle ages are low relative to those in the older ages, future gains in mortality and life expectancy will largely be achieved through a continued reduction in mortality in older people.

Most reports on burden of heart disease in Canada have focused on mortality. We know, however, that mortality reflects only one perspective of health. The present report is one of the first in Canada to report findings on CVD prevalence and its impact on HRQOL. The results indicate that many people, especially older people, live with heart disease. People with heart disease have a much lower HRQOL than people without heart disease. The combination of high prevalence, high death rate and high impact on HRQOL means that heart disease was also the leading cause of health expectancy lost in Canada (23).

The difference in the burden of heart disease between Canadian men and women narrowed considerably when disease prevalence and HRQOL burden were considered. Women may have had a much lower CVD death rate than men but disease prevalence was similar between the sexes. Women who live with the disease had greater limitations of HRQOL, including greater functional limitations, such as getting around or living with pain, and activity restrictions such as bathing, cooking or shopping.

It is important not only to add ‘years to life’ but also to add ‘life to years’, meaning improvements in life expectancy should ideally be accompanied by improvements in HRQOL (17). Efforts to reduce diseases that are fatal will add ‘years to life’, while reducing diseases that affect HRQOL will add ‘life to years’. Because diseases such as arthritis and mental health largely affect HRQOL more than they affect mortality, reducing their effect or eliminating them will mostly add ‘life to years’. Given the present burden of disease on HRQOL, reducing or eliminating heart disease will result in an increase in life expectancy that will be larger than the gains in health expectancy (Figure 12). The potential for extending life expectancy without correspondingly large increases in HALE would result in a greater number of years lived in poor health, which is referred to as an ‘expansion of morbidity’ (24). In turn, this may result in a larger proportion of older people living in a disabled state and may place greater demands on the health care system and supportive services such as adequate housing, accessible public facilities, and assistance from family and friends.

To examine how to reduce the burden of CVD, it is first helpful to separate the different ways in which heart disease affects health. The total disease burden on HRQOL depends on the number of people who develop heart disease (disease incidence), the length of time people live with the disease and the level of HRQOL resulting from CVD. The mortality burden of CVD depends not only on the prevalence of disease but also on how quickly it progresses to a severe state that can no longer support vital function. Given this perspective, there are two main methods of reducing the burden of heart disease. Primary prevention aims to delay the onset of disease by reducing risk factors such as tobacco use, poor diet, obesity and lack of physical activity. Observational studies suggest that primary prevention may have contributed to about one-half of the reduction in heart disease over the past 20 to 30 years (25,26). Because heart disease risk factors in Canada remain common,
there are likely important gains in the burden of heart disease that can be achieved through risk factor modification, if community-based and individual interventions are available. There is the potential for even larger gains in the total burden of disease because CVD behavioural risks are also associated with deaths and disabilities from other chronic conditions, such as diabetes and cancer.

Disease treatment aims to improve heart function and slow the progression of disease, which in turn improves survival, symptoms, functional limitations and other aspects of HRQOL. Because current medical and hospital therapies focus on improving HRQOL along with survival, there is the potential that future increases in HALE will be larger than life expectancy increases, leading to both a longer life expectancy and a greater proportion of life lived in a healthy state.

There are several limitations of this study. The HRQOL measures rely on self-reports, which have been shown to underrepresent disease prevalence for several chronic diseases (27-30). Other Canadian studies have improved reporting by linking disease registries to health surveys (31). In addition, discussion regarding the future life and health expectancy estimates and impact of interventions is difficult because they are based on the current burden of CVD in relationship to other diseases, and there is inadequate information on the effectiveness of health interventions in communities. Greater work needs to be done to model these disease relationships and effectiveness of interventions.

Heart disease is the most important disease contribution to differences in health among many populations in Canada. In addition to the large contribution in life expectancy differences between men and women, there are substantial differences in the burden of heart disease among Canadian health regions and socioeconomic groups (32). Any effort to reduce heart disease should specifically address the health needs of these populations (33).

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Figure 13) Life expectancy lost (in years) due to cardiovascular disease in men and women in Canada, by health region (HR), from 1995 to 1997. P.E.I. Prince Edward Island. Data from Statistics Canada, 2001
APPENDIX A
International Classification of Diseases, eighth and ninth revision (ICD-8 and ICD-9) codes used in exhibits to signify the most responsible underlying condition on the death certificate

<table>
<thead>
<tr>
<th>Cause of death</th>
<th>ICD revision and codes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidents/poisonings/violence</td>
<td>ICD-9 E800-E999</td>
</tr>
<tr>
<td>Accidents and suicides</td>
<td>ICD-9 E800-E929, E950-E959</td>
</tr>
<tr>
<td>Cardiovascular disease</td>
<td></td>
</tr>
<tr>
<td>1969 to 1978</td>
<td>ICD-8 390-458</td>
</tr>
<tr>
<td>1979 to 1996</td>
<td>ICD-9 390-459</td>
</tr>
<tr>
<td>Ischemic heart disease</td>
<td>ICD-9 410-414</td>
</tr>
<tr>
<td>Acute myocardial infarction</td>
<td>ICD-9 410</td>
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<tr>
<td>Cerebrovascular disease</td>
<td>ICD-9 430-438</td>
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<td>Cancer</td>
<td>ICD-9 140-239</td>
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<tr>
<td>Diabetes</td>
<td>ICD-9 250</td>
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<tr>
<td>Infectious diseases</td>
<td>ICD-9 001-139</td>
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<tr>
<td>Respiratory diseases</td>
<td>ICD-9 460-519</td>
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REFERENCES