Life expectancy
as a measure of population health:
Comparing British Columbia with other Olympic and Paralympic Winter Games host jurisdictions

Summary Report

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BRITISH COLUMBIA
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Foreword

The BC government has set an ambitious goal for 2010 – that BC will be the healthiest jurisdiction to ever host the Olympic and Paralympic Winter Games.

This novel and significant public commitment by government is to be commended. Government policymakers and health authorities have responded to this goal with a variety of programs aimed at encouraging British Columbians to lead healthier lifestyles.

Assessing British Columbia's current health status and its progress toward the government's 2010 goal requires comparison between BC and the world's most developed – and healthiest – countries.

To enable this comparison and to help further discussion on how BC might best reach the 2010 goal, we looked at possible measures for comparing levels of health across jurisdictions. One such measure is life expectancy, a reliable and often-used measure of population health.

Using life expectancy at birth as an overall measure of population health, this study projects recent trends in life expectancy to the year 2010 to predict the health status of people in BC relative to people from the healthiest countries of the world, including those which have been Olympic and Paralympic Winter Games hosts in the past.

Our analysis is based on current trends and assumes no change in efforts to improve life expectancy. It cannot, for example, project the positive effect of recent initiatives such as ActNow BC. While it is possible these initiatives will favourably affect life expectancy in BC, it is still too early to assess their long-term impact.

Although the results of our analysis confirm that British Columbians are among the healthiest people in Canada and the world and that the life expectancy of both men and women continues to improve. However, they also reveal areas of possible concern – where BC's recent progress is starting to recede. BC men are living longer than ever before, but their progress is more than offset by the much slower life expectancy gains being made by BC women.

These trends, combined with projected improvements by other nations, mean British Columbia is unlikely to achieve its 2010 goal, if it is measured by life expectancy. More importantly, they indicate that policymakers and health authorities need to consider several trends of concern as they plan services and programs for improving the health of British Columbians. In particular, we see a number of lifestyle-related health issues negatively affecting the life expectancy of women in this province.

PHSA will consider the data from this report in strategic planning for BC Women's Hospital & Health Centre and in planning with the Women's Health Research Institute and the Centre for Excellence in Women's Health. We trust that government policymakers and regional health authorities will also find value from the analysis provided in this report.

John Millar
PHSA Executive Director,
Population Health Surveillance & Disease Control Planning

Executive Summary

Life expectancy at birth (*LE0*), the average number of years a newborn can be expected to live given prevailing mortality rates, offers a reliable indicator of overall health for populations and is a frequently used and analyzed component of demographic data.

The objectives of the current study were to assess the global ranking of British Columbia in terms of *LE0*, and to determine the areas of greatest negative impact on *LE0* for British Columbians. Using retrospective *LE0* values and recent *LE0* trends, BC as a distinct sub-national jurisdiction was compared with the 14 healthiest countries in the world*. Life expectancy projections were developed for all jurisdictions in the study to the year 2010, when BC will host the Olympic and Paralympic Winter Games.

Consideration was given to comparing BC's projected 2010 *LE0* to the *LE0* of other Winter Olympic Games host jurisdictions in the years that they hosted the Games. Although that approach has some merit, for this report it was decided a more meaningful result would be produced by comparing projected *LE0* for all jurisdictions to 2010.

On the basis of *LE0*, BC men were found to be world leaders – a position they have held since 2003. Furthermore, BC men are projected to maintain this front rank position until 2010, and possibly beyond. Although BC women still live longer on average than their male counterparts, the current study revealed that BC women currently rank third (based on the most recent data) against the leading nations for *LE0*, and are projected to fall to seventh place by 2010, behind the women of Spain and Australia, and former Winter Olympic host nations Japan, France, Italy and Switzerland.

Comparisons of cause-specific mortality rates for BC and the 14 healthiest countries of the world were also done to assess BC's position relative to the highest international standards of population health, and to identify the most significant areas for improvement. From this comparison it was found that BC men had higher mortality rates than men from the healthiest countries in two areas: ischemic heart disease and respiratory system disease, with half of all respiratory system deaths due to influenza and pneumonia. On the other hand, in comparison with these same 14 countries, BC men had the lowest mortality rate for cancer.

Compared to women from the healthiest countries of the world, BC women were found to have higher mortality rates for cancer (especially lung cancer), ischemic heart disease and respiratory system diseases (especially influenza and pneumonia). BC women are also experiencing a faster increase in their rates of overweight/obesity and diabetes than BC men.

Current trends indicate that by 2010, British Columbians overall will not have longer life expectancy at birth than other Olympic and Paralympic Winter Games host jurisdictions. The world-leading *LE0* ranking of BC men in 2010 will be offset by a decline in the ranking for BC women and overall, British Columbians will rank third for *LE0* among all Olympic and Paralympic Winter Games host jurisdictions.

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*   Only those countries with a high life expectancy and a minimum population of one million were included in this study for comparision.

Introduction

Life expectancy is a useful indicator for comparing the health status of societies. It can also be a proxy measure for the quality or prevalence of such social conditions as wealth, economic opportunity, healthcare, and education. For this reason, inequities in life expectancy usually signal inequities in other social, economic and environmental conditions.

Over the past century, global improvements in public health, medicine, living, working and economic conditions and nutrition have led to a dramatic increase in life expectancy[1]. In 1921 in BC for example, life expectancies at birth were 60.3 and 64.2 years for men and women respectively. By 2004 life expectancies in BC had increased by about 30%, to 78.7 and 83.0 years respectively.

The reason for the persistent gap in life expectancy between women and men is not fully understood. Some scientists have suggested a biological basis for the longer life expectancies of women. Others believe the difference is caused by men engaging in more hazardous activities than women. Among developed countries, however, the gap in *LE0* between men and women has become progressively smaller in recent decades.

This report provides an assessment of the health status of British Columbians relative to the health status of people from the healthiest countries of the world, using life expectancy as the basis for comparison. Based on an analysis of life expectancy trends from 1989 to 2003, the report also provides life expectancy projections for all jurisdictions in the study to the year 2010.

Although it must be acknowledged that BC represents a sub-national jurisdiction, the availability of reliable *LE0* data from all jurisdictions in this report supports a comparison of relative health status between BC and the countries included in this study.

Methods

Jurisdictions under Comparison

Estimates of life expectancy and mortality rates are sensitive to population size. To ensure reliable *LE0* comparisons, the countries selected for this study were limited to those with high *LE0* and populations over 1,000,000. This included the following 14 countries (former Winter Olympic Games hosts in **bold**): **Japan**, **Switzerland**, Sweden, Australia, **Canada**, Spain, **Norway**, New Zealand, **Italy**, Netherlands, **France**, **Austria**, Greece and Finland. From this list, seven countries (Canada, Switzerland, Japan, France, Italy, Australia, Spain and Sweden) are consistently in the top rank globally for having the lowest population morality rates and highest life expectancies.

All but three former Winter Olympic Games host countries meet the above requirements. Relatively short life expectancies exclude the United States, a three-time Winter Games host, and 1936 host, Germany. Short life expectancy and lack of reliable data due to civil war excludes the former Yugoslavia, the 1984 host country.

Source of Data

All data compiled for this report were taken from existing sources. Life expectancy data, annual age-specific mortality counts and demographic characteristics for British Columbians were obtained from BC Vital Statistics and the BC Health Data Warehouse. Health status indicators for BC were obtained from Statistics Canada.

Health status and life expectancy data for the countries included for study in this report were obtained from the Organization for Economic Cooperation and Development (OECD) *Health Data 2005 – Statistics and Indicators for 30 Countries*, an annual report from OECD Health Division. (All 14 countries under comparison are OECD member countries.)

Rate Standardization

Mortality rates are influenced by the age distribution of a population, i.e. younger populations tend to have lower mortality rates. To ensure mortality rates were fully comparable between BC and the countries studied for this report, age-standardized mortality rates[2, 3] per 100,000 of population were used.[†] The reference population for mortality rate standardization is the 1980 OECD population.

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†   Age-standardized mortality rates (ASMR) are used to compare the mortality rates of different population groups adjusted for differences in age distribution.

Data Analysis

To establish a reliable basis for projecting *LE0* values to 2010, *LE0* trends were analysed from data reflecting a period of time (1989 to 2003) twice as long as the projection period (2004 to 2010).

Data analysis involved simple linear regression[4, 5, 6, 7] on calendar year with short-term projections for *LE0* and for log-transformed age-standardized mortality rates.[8, 9] (For a more detailed description of data analysis, see the Appendix.)

Results

Life Expectancy Comparisons Over Time

Figure 1 shows a steady increase in *LEo* for both men and women in BC and Canada between 1989 and 2003. Projecting to 2010, BC women on average can still be expected to live between four and five years longer than men. However, *LEo* for BC men is increasing faster than for BC women. In fact, the gap in *LEo* between men and women in BC has declined by almost half since the mid 1970s, from 7.8 years to 4.4 years.

Figure 1. Male and female life expectancies at birth for British Columbia and Canada
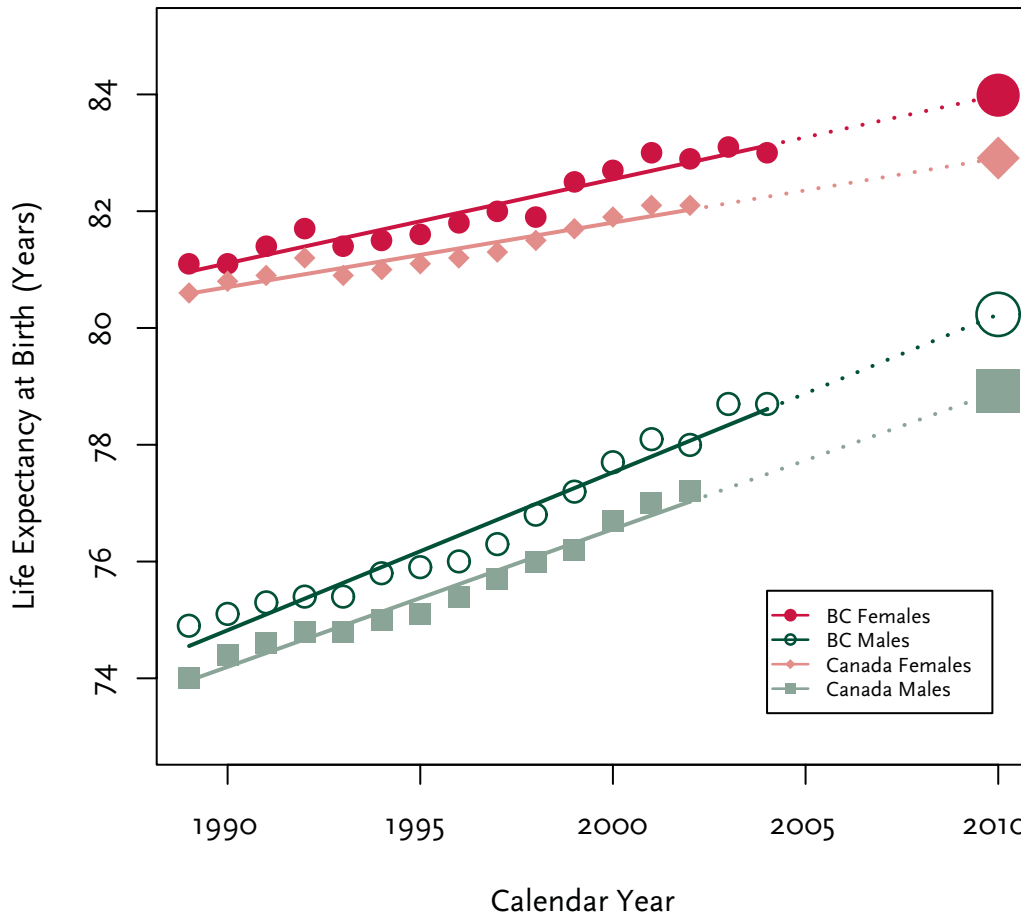
(Data sources: BC Vital Statistics, BC Ministry of Labour and Children, OECD Health Data 2005)

In reviewing global life expectancy data, BC emerges as one of the world leaders. In fact, as shown in Figure 2, BC men assumed the front rank in *LEo* globally in 2003, after surpassing the Japanese. Projecting the trendline for *LEo* into the future, BC men can be expected to retain their global leadership for *LEo* at least until 2010, when the Olympic and Paralympic Winter Games will be held in the province.

Figure 2. *LE0* **(actual and projected) for men from BC and the healthiest nations of the world**
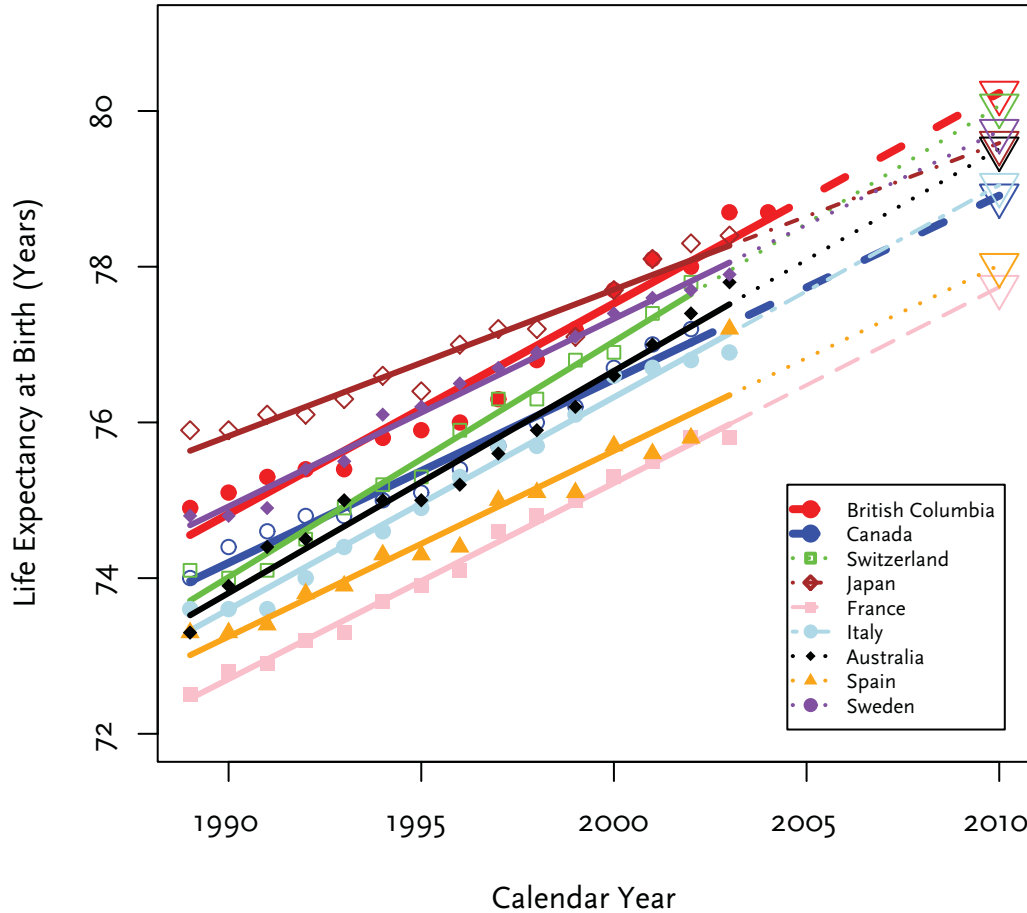
(Data sources: BC Vital Statistics, BC Ministry of Labour and Children, OECD Health Data 2005)

As shown in Figure 3, BC women are also among the healthiest in the world. In 2003, the latest year for which data are available, BC women ranked third for *LE0* in comparison with women from the healthiest countries. However, the *LE0* projection for BC women indicates they are unlikely to maintain this position in the coming years, and by 2010 they are expected to slip to seventh place for *LE0* against women from the world's healthiest nations.

Figure 3. *LE0* (actual and projected) for women from BC and the healthiest nations of the world
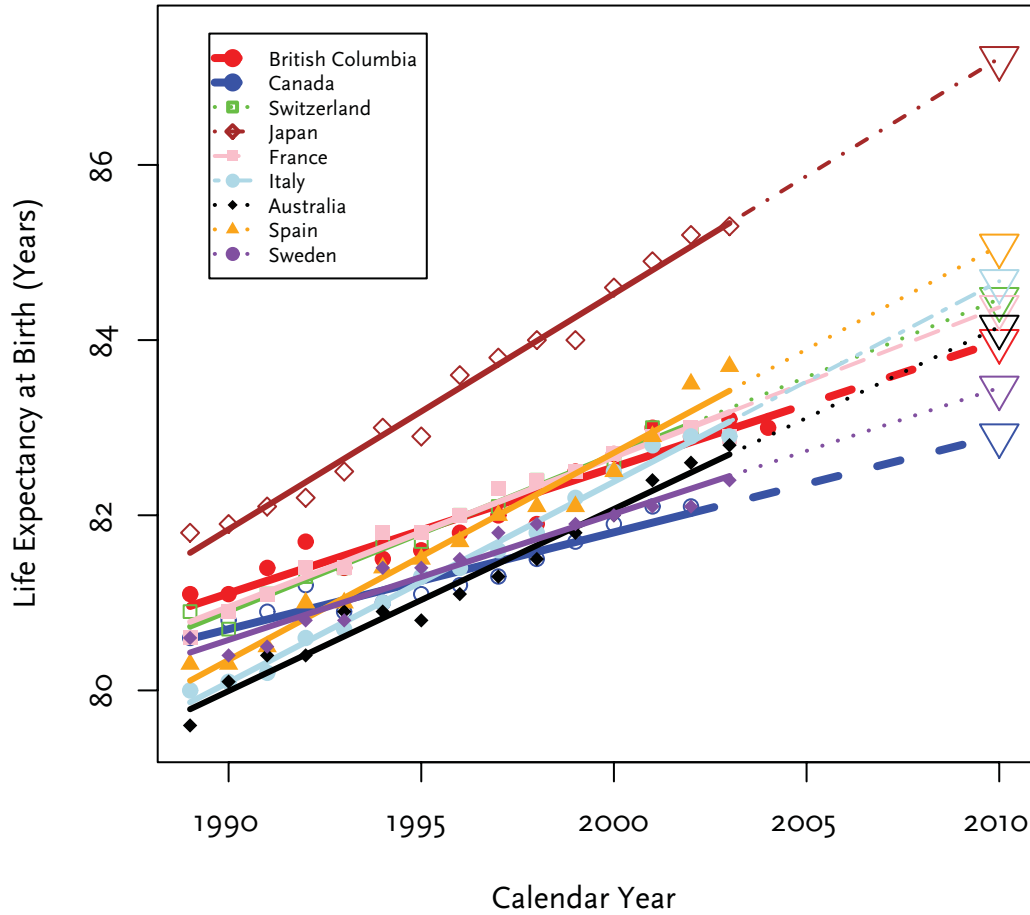

(Data sources: BC Vital Statistics, BC Ministry of Labour and Children, OECD Health Data 2005)

A summary of male and female life expectancy levels between 1989 and 2003 for BC and the world's 14 healthiest countries is presented in Tables 1 and 2.

Table 1. Male life expectancy at birth for BC, Canada and selected healthiest countries

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
BC	74.9	75.1	75.3	75.4	75.4	75.8	75.9	76.0	76.3	76.8	77.2	77.7	78.1	78.0	78.7
Japan	75.9	75.9	76.1	76.1	76.3	76.6	76.4	77.0	77.2	77.2	77.1	77.7	78.1	78.3	78.4
Switzerland	74.1	74.0	74.1	74.5	74.9	75.2	75.3	75.9	76.3	76.3	76.8	76.9	77.4	77.8	78.0
Sweden	74.8	74.8	74.9	75.4	75.5	76.1	76.2	76.5	76.7	76.9	77.1	77.4	77.6	77.7	77.9
Australia	73.3	73.9	74.4	74.5	75.0	75.0	75.0	75.2	75.6	75.9	76.2	76.6	77.0	77.4	77.8
Canada	74.0	74.4	74.6	74.8	74.8	75.0	75.1	75.4	75.7	76.0	76.2	76.7	77.0	77.2	77.4
Spain	73.3	73.3	73.4	73.8	73.9	74.3	74.3	74.4	75.0	75.1	75.1	75.7	75.6	75.8	77.2
Norway	73.3	73.4	74.0	74.2	74.2	74.9	74.8	75.4	75.5	75.6	75.6	76.0	76.2	76.4	77.0
New Zealand	71.9	72.4	72.9	73.1	73.4	73.7	74.4	74.4	74.4	75.2	76.0	76.3	76.3	76.3	77.0
Italy	73.6	73.6	73.6	74.0	74.4	74.6	74.9	75.3	75.7	75.7	76.1	76.6	76.7	76.8	76.9
Netherlands	73.7	73.8	74.0	74.3	74.0	74.6	74.6	74.7	75.2	75.2	75.3	75.5	75.8	76.0	76.2
France	72.5	72.8	72.9	73.2	73.3	73.7	73.9	74.1	74.6	74.8	75.0	75.3	75.5	75.8	75.8
Austria	71.9	72.2	72.3	72.5	72.8	73.2	73.3	73.7	74.1	74.5	74.8	75.1	75.6	75.8	75.6
Greece	74.5	74.6	74.7	74.7	75.0	75.2	75.0	75.1	75.6	75.4	75.5	75.5	75.4	75.4	75.4
Finland	70.9	70.9	71.3	71.7	72.1	72.8	72.8	73.0	73.4	73.5	73.8	74.2	74.6	74.9	75.1

(Data sources: BC Vital Statistics, BC Ministry of Labour and Children, OECD Health Data 2005)

Table 2. Female life expectancy at birth for BC, Canada and selected healthiest countries

	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
BC	81.1	81.1	81.4	81.7	81.4	81.5	81.6	81.8	82.0	81.9	82.5	82.7	83.0	82.9	83.1
Japan	81.8	81.9	82.1	82.2	82.5	83	82.9	83.6	83.8	84	84	84.6	84.9	85.2	85.3
Spain	80.3	80.3	80.5	81	81	81.4	81.5	81.7	82	82.1	82.1	82.5	82.9	83.5	83.7
Switzerland	80.9	80.7	81.1	81.3	81.4	81.7	81.7	82	82.1	82.4	82.5	82.6	83	83	83.1
France	80.6	80.9	81.1	81.4	81.4	81.8	81.8	82	82.3	82.4	82.5	82.7	82.9	83	82.9
Italy	80	80.1	80.2	80.6	80.7	81	81.3	81.4	81.6	81.8	82.2	82.5	82.8	82.9	82.9
Australia	79.6	80.1	80.4	80.4	80.9	80.9	80.8	81.1	81.3	81.5	81.8	82	82.4	82.6	82.8
Canada	80.6	80.8	80.9	81.2	80.9	81	81.1	81.2	81.3	81.5	81.7	81.9	82.1	82.1	82.4
Sweden	80.6	80.4	80.5	80.8	80.8	81.4	81.4	81.5	81.8	81.9	81.9	82	82.1	82.1	82.4
Norway	79.8	79.8	80.1	80.3	80.2	80.6	80.8	81	81	81.3	81.1	81.4	81.5	81.5	81.9
Finland	78.9	78.9	79.3	79.4	79.5	80.1	80.2	80.5	80.5	80.8	81	81	81.5	81.5	81.8
Austria	78.6	78.8	78.9	79.1	79.3	79.6	79.9	80.1	80.5	80.8	80.8	81.1	81.5	81.7	81.6
New Zealand	78	78.3	78.7	78.9	79.1	79.1	79.7	79.7	79.7	80.4	80.9	81.1	81.1	81.1	81.3
Netherlands	79.9	80.9	80.1	80.3	80	80.3	80.4	80.3	80.5	80.6	80.5	80.5	80.7	80.7	80.9
Greece	79.4	79.5	79.7	79.6	79.9	80.2	80.3	80.4	80.8	80.4	80.6	80.6	80.7	80.7	80.7

(Data sources: BC Vital Statistics, BC Ministry of Labour and Children, OECD Health Data 2005)

Comparison of Recent Life Expectancy Trends

Table 3 compares the relative rate of improvement in *LE0* for BC and the 14 healthiest nations of the world. From this perspective, BC and Canada rank well behind the fastest improving countries. Based on their annual rate of *LE0* improvement of 0.143, or 52 days per year, BC women rank 11th in the world. In comparison, the annual *LE0* gain for Japanese women is 0.268, or 98 days per year, while the gain for women in New Zealand is 0.252, or 92 days per year.

By the same measure, BC men rank seventh against men from the world's healthiest countries, with an annual estimated life expectancy gain at birth of 0.270, or 99 days per year. This is considerably less than the annual gain for New Zealand men at 0.356, or 130 days per year, and for men from Finland at 0.310, or 113 days per year. Nevertheless, life expectancy for BC men is increasing at almost twice the rate for BC women.

Table 3. Comparison of *LEo* improvement trends by incremental slope[※][§]

Rank	Male		Female	
	Jurisdiction	Slope	Jurisdiction	Slope
1	*New Zealand*	0.356	*Japan*	0.268
2	*Finland*	0.310	*New Zealand*	0.252
3	Switzerland	0.302	*Austria*	0.238
4	Austria	0.299	*Spain*	0.236
5	Australia	0.285	*Italy*	0.228
6	Italy	0.272	*Finland*	0.212
7	BC	0.270	*Australia*	0.207
8	France	0.251	*Switzerland*	0.178
9	Norway	0.244	France	0.171
10	Sweden	0.241	Norway	0.144
11	Spain	0.238	BC	0.143
12	Canada	0.235	Sweden	0.143
13	Japan	0.188	Canada	0.110
14	Netherlands	0.179	Greece	0.101
15	Greece	0.072	Netherlands	0.042

Comparison of Life Expectancies Projected to 2010

Projecting *LEo* for BC and countries that have hosted the Olympic Winter Games in the past reveals a different picture for BC men and women, as shown in Figure 4. BC men in 2010 are projected to have a longer *LEo* than men from all previous Olympic Winter Games host jurisdictions. However, BC women in 2010 will rank fifth for *LEo* among women from previous Olympic Winter Games host jurisdictions, behind Japan, France, Italy and Switzerland. (Globally, BC women in 2010 will rank seventh for *LEo* among women from the healthiest countries.) On a combined basis, reflecting *LEo* projections for both men and women, in 2010 BC will rank third for *LEo* among Olympic Winter Games host jurisdictions, behind Japan and Switzerland,

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[※] Incremental slope indicates the typical increase in ***LEo*** for a single year. For example, the slope for BC men of 0.270 represents 0.270 of a year increase in life expectancy at birth for each year during the regression period, and provides a good estimate of annual increase for coming years over a short term. Incremental slopes were derived from 1989-2003 data based on linear regression models.

[§] Countries shown in italics in this table are gaining life expectancy at a much faster rate (statistically significant at p=0.05 level) than BC based on the Student's t tests on regression slops.

Table 4. *LEo* projections to 2010 for BC and seven former Olympic Winter Games host nations¶

Host	Year of Games	*LEo* in 2010 (projected)		
		Men	Women	Combined (men and women)
BC	2010	80.2	84.0	82.2
Italy	2006	79.0	84.7	81.9
USA	2002	76.4	80.5	78.5
Japan	1998	79.6	87.2	83.4
Norway	1994	78.5	82.9	80.7
France	1992	77.7	84.4	81.1
Canada (Calgary)	1988	78.9	82.9	81.0
Switzerland	1948	80.1	84.5	82.3

Leading Causes of Premature Death

Increased life expectancy can be directly related to reductions in the incidence of premature death. In this study, premature death is defined as any death prior to the age of 75.

In BC, chronic diseases and injuries account for more than 90% of all deaths. In 2004, the three main causes of premature death in BC were cancers (47.8% for men, 34.7% for women), circulatory system diseases (17.2% for men, 23.3% for women) and injuries (7.8% for men, 15.0% for women).

Among all cancer deaths for BC men, 27.0% are due to lung cancer, 8.7% to colorectal cancer and 6.4% to pancreatic cancer. Among all cancer deaths for BC women, 27.9% are due to lung cancer, 16.8% to breast cancer and 7.5% to colorectal cancer.

Also in 2004, ischemic heart disease and cerebrovascular disease (stroke) accounted for about 70% of all circulatory system diseases causing premature death among British Columbians. Most premature deaths by injury in BC are caused by motor vehicle accidents and suicide.

¶   The two other countries that are projected to have longer female *LEo* than BC in 2010 (Spain and Australia) have never been Olympic Winter Games hosts. Men and women from other former Olympic Winter Games hosting countries, such as Germany, Austria and the former Yugoslavia, are projected to have shorter life expectancies in 2010 than BC men and women.

Cause-Deleted Life Expectancy

Cause-deleted life expectancy (CDLE)[10, 11] estimates the increase in life expectancy that would result if a specific cause of death were eliminated within a population. As shown in Table 5, cancers reduced LE_0 for both BC men and women by 4.0 years, while circulatory system disease reduced LE_0 by 5.4 years and 6.4 years for men and women respectively. Injuries reduced LE_0 for BC men and women by 1.5 and 0.7 years respectively.

Table 5. Selected cause-deleted life expectancy at birth (CDLE) in BC in 2004[**]

	Male			Female		
Description	LE_0	Gain	CDLE_0	LE_0	Gain	CDLE_0
Baseline level (2004)	78.9			83.4		
If all cancer cured		4.0	82.9		4.0	87.4
If lung cancer cured		0.9	79.8		1.0	84.4
If prostate cancer cured		0.4	79.3		n/a	n/a
If female breast cancer cured		n/a	n/a		0.6	84.0
If all circulatory system disease cured		5.4	84.3		6.4	89.8
If ischemic heart disease cured		2.1	81.0		1.8	85.2
If cerebrovascular disease cured		0.7	79.6		1.2	84.6
If all injuries avoided		1.5	80.4		0.7	84.1
If land transport accidents avoided		0.4	79.3		0.2	83.6

(Data sources: BC Vital Statistics, BC Ministry of Labour and Children, OECD Health Data 2005)

# Disease-specific Mortality Rates

Age-standardized mortality rates (ASMR) were used to make valid comparisons of disease-specific mortality for all jurisdictions studied for this report.

For each specific cause of death in a specific year, the difference in ASMR values for BC and the best performing country were calculated. The results are shown in Figures 4 and 5. A positive difference indicates BC had a higher mortality rate than the foremost country for that cause of death in that year, and indicates the magnitude of improvement required for BC to surpass the foremost jurisdiction. Conversely, a negative difference indicates BC's position as the leader among all jurisdictions.

[**] Life expectancy values were calculated using the abridged life table method, which may result in slight differences from officially published numbers extracted from complete life tables.

As shown in Figure 4, BC women are far behind women of the foremost countries in ischemic heart disease, all cancers (especially lung cancer) and respiratory system diseases. However, the mortality rate for BC women due to ischemic heart disease has been continuously improving relative to the foremost country on this measure.
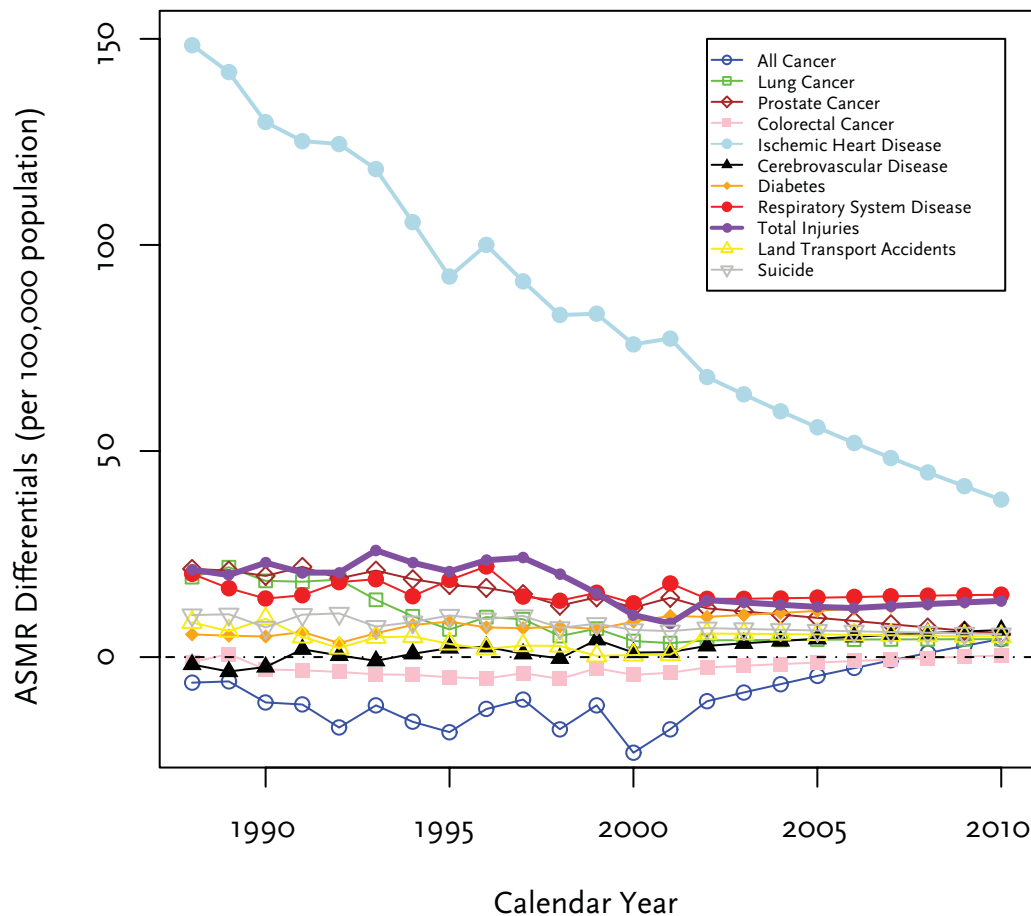
Figure 4. The position of BC women relative to leading countries by mortality risk
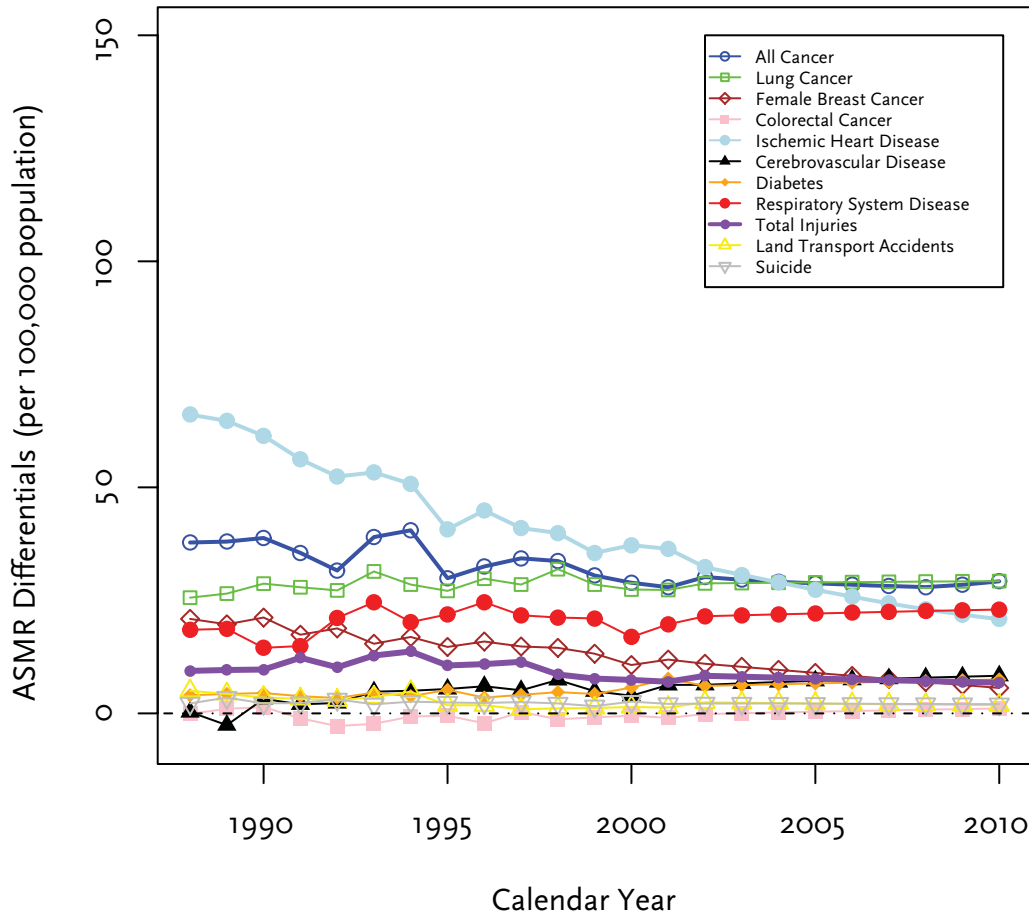
(Data sources: BC Vital Statistics, BC Ministry of Labour and Children, OECD Health Data 2005)

As shown in Figure 5, the ASMR values for BC men are close to those for men in the foremost countries for all major diseases except ischemic heart disease, in which case BC men are still behind the foremost countries but rapidly improving. It should be noted that at the time of this report, BC men had the lowest all-cancer mortality rate among all jurisdictions studied.

Figure 5. The position of BC men relative to leading countries by mortality risk

Legend:
- All Cancer
- Lung Cancer
- Prostate Cancer
- Colorectal Cancer
- Ischemic Heart Disease
- Cerebrovascular Disease
- Diabetes
- Respiratory System Disease
- Total Injuries
- Land Transport Accidents
- Suicide

Y-axis: ASMR Differentials (per 100,000 population)

X-axis: Calendar Year

(Data sources: BC Vital Statistics, BC Ministry of Labour and Children, OECD Health Data 2005)

# Gender-related Differences Affecting Life Expectancy

The gap in *LE0* between BC women and men is not a constant and can be affected by such variables as employment status, environmental influences, socio-economic status, ethnicity and lifestyle. In the last century this gap grew continuously, reaching a peak of 7.8 years in 1975, and has subsequently dropped to 4.4 years. (See Figure 6.) This phenomenon is possibly explained by the high male mortality rates for ischemic heart disease and lung cancer prior to the 1970s, and the decreased mortality rate in ischemic heart disease for men and the high smoking-related lung cancer mortality rate for women since that time.

Obesity and Diabetes

A further possible explanation for the declining gap in *LE0* between BC men and women may be found in the faster rate of increase in overweight/obesity and in the increasing prevalence of diabetes among BC women compared to men over the past decade. According to the most recent data[††], between 1994 and 2005 the rate of obesity for BC men rose from 11.0% to 14.1%, a relative increase of 28.2%, while the rate of obesity for BC women climbed from 9.4% to 12.2%, a relative increase of 29.8% Over the same period the rate of overweight among BC men declined from 43.4% to 39.9%, a relative drop of 8.1%, while the rate of overweight among women in the province rose from 22.4% to 24.2%, a relative increase of 8.0%.

Similarly, between 1994 and 2005 the rate of increase in the prevalence of diabetes for BC women (104.8%) was considerably higher than the rate of increase for BC men (45.5%).

### Figure 6. Gap in life expectancy at birth between BC women and men
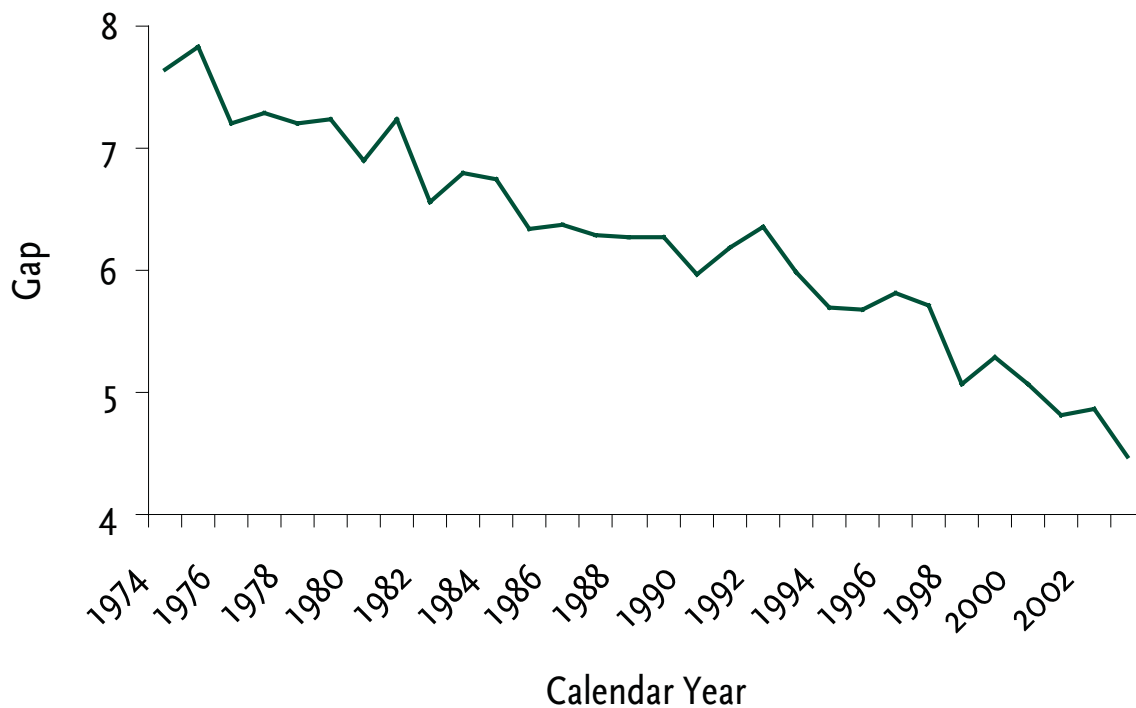
(Data Sources: BC Vital Statistics, BC Ministry of Labour and Children)

More Women Joining the Workforce

As shown in Figure 7, the participation of women in the BC labour force has increased from 47% in the 1970s to 60% in 2000. This increased participation of women in the workforce may have contributed to higher levels of stress for women and may have increased their susceptibility to disease, offering one possible explanation for the reduced gap between male and female life expectancy in BC. (Over the same period, the percentage of BC men in the labour force dropped from 78% to 70%.)

**Figure 7. Labour force participation by gender in BC**
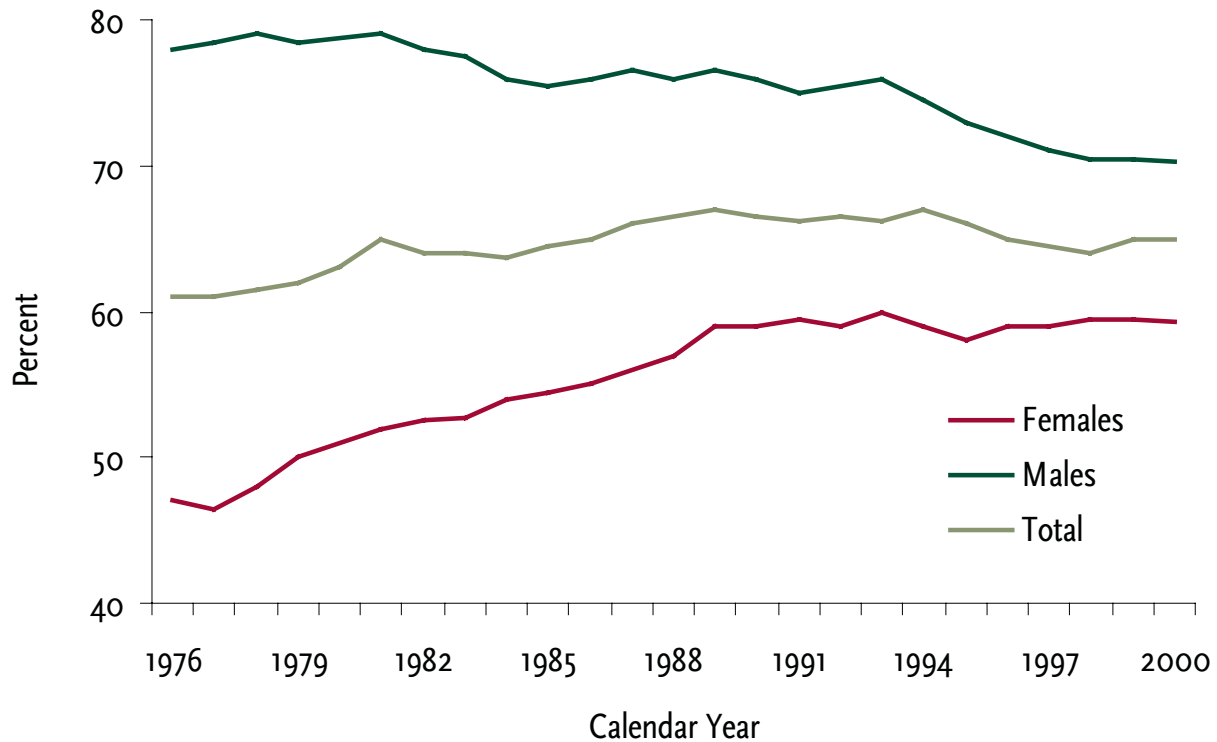
(Data Sources: BC Vital Statistics, Labour Force Participation Rate Model)

Differences in Smoking Patterns

Tobacco use is another significant determinant of life expectancy. The present trend for smoking-related mortality reflects the impact of smoking behaviours from 20 to 30 years ago. Figure 8 shows a continuous decline in the number of Canadian male and female smokers since the 1960s. The effect of declining tobacco use by men, which began in the late 1960s, is reflected by a levelling off and subsequent decline in male lung cancer rates. In contrast, female smoking rates didn't peak until the 1970s and have declined slightly in the past three decades. As a result, female lung cancer mortality rates increased about 300% from 1971 to 2001, and should continue to rise for the next few years before starting to decline, reflecting the reduced number of female smokers.

Figure 8. Smoking rates by gender in Canada
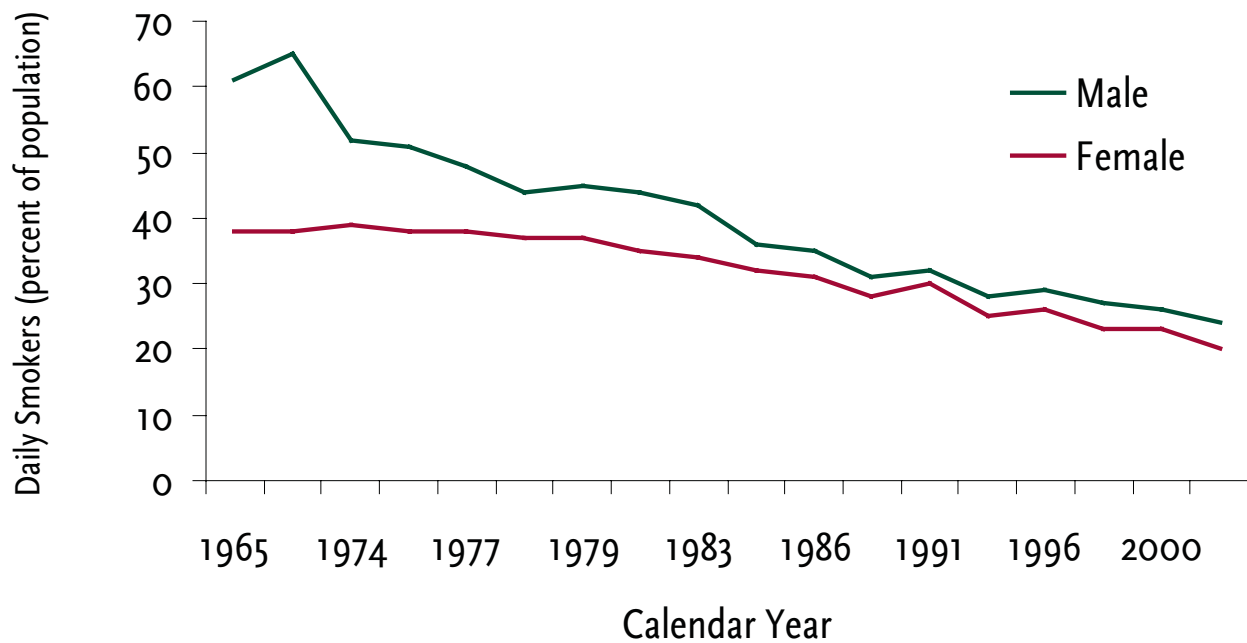
(Data source: Physicians for a Smoke-Free Canada – March 2005)

Discussion

British Columbians are among the healthiest people in the world. In fact, using *LEo* as a measure of health status, BC men rank first in a comparison with men from the healthiest countries of the world, and will continue to hold that position at least until 2010, when BC will host the Olympic and Paralympic Winter Games.

The strong showing for BC men on *LEo* may be explained in part by a reduction in the number of deaths related to ischemic heart disease. This in turn is attributable to improvements in clinical care, lifestyle activities, and socioeconomic conditions.

BC women, ranked third for health status based on the most recent *LEo* data (2003), are also among the world's healthiest. However, if current trends continue, BC women will not maintain their present ranking in relation to women from the world's healthiest nations, and are projected to fall to seventh place by 2010.

This decline in *LEo* ranking for BC women in comparison with women from the healthiest nations may partly be explained by BC women experiencing relatively higher rates of mortality associated with cancer (especially lung cancer), respiratory disease and cardiovascular disease.

These trends, in turn, are related to historical smoking trends and the greater susceptibility of women (vs. men) to lung cancer. BC women are also experiencing rising rates of overweight/obesity and an associated increase in the incidence of diabetes.

Regarding the question whether BC will be the healthiest jurisdiction to ever host the Olympic and Paralympic Winter Games, the answer is different for BC men and women. For BC men, the answer is yes. In comparison with men from the healthiest countries of the world – including all countries which have hosted Olympic Winter Games in the past – BC men are currently the healthiest and are projected to maintain their leading position for *LEo* at least until 2010.

BC women, however, currently ranked third for *LEo* relative to women from the healthiest nations of the world, are projected to fall to seventh place by 2010.

This projected decline in *LEo* for BC women by 2010 will offset the front-rank *LEo* results for BC men and means the province is unlikely to be the healthiest jurisdiction (based on life expectancy) to have ever hosted the Olympic Winter and Paralympic Games.

More importantly, our analysis reveals that the health status of BC women is slipping relative to the health status of BC men and of women from the healthiest countries of the world, and will probably continue to do so unless current trends can be effectively addressed.

Appendix I

Detailed Explanation of Data Analysis

For reasons outlined below, simple linear regression models[4] were used for short-term *LE0* projection and linear regression on the log of the age-standardized mortality rates[8,9] for mortality rate projections in our study.

Female life expectancy in the healthiest countries displays a remarkably linear trend, increasing by an increment of about three months per year over the past 160 years as described in an important article by Oeppen and Vaupel.[5] The healthiest country at any particular time exemplifies an ideal environment in which there were no wars, large-scale disease outbreak or natural disasters. This is true for most Western developed nations of today. In another study, White[6] filtered out the fluctuations of individual countries by averaging the life expectancies of twenty-one high-income countries and discovered that average *LE0* increased linearly by 0.208 of a year per year over 40 years.

Linear regression models also have the potential to eliminate fluctuations due to exotic disease epidemics such as SARS, since the mortalities from these incidental diseases usually do not continue or repeat and therefore should not be used in the base model to predict future circumstances.

Finally, excepting BC and Canada, we did not have detailed age and cause-specified mortality rates and longitudinal demographic description for all jurisdictions under comparison. In order to compare all jurisdictions on a common basis, we adopted the linear regression model to project future life expectancies and linear regression on the log of the age-standardized mortality rates to model and project mortality rates instead of such other approaches as the Poisson regression or Lee-Carter's time series method, which is usually used for long-range mortality projections[11] if detailed mortality data is available.

The extent of the linear relation of life expectancy over time is expressed as R-squared (R2). In our models, R2 for the BC model and the models for most of the countries studied in this report were greater than 90%, which means more than 90% of the variations in life expectancy can be explained by the regression models. Further, regression slope is a measure of rate of linear increase. In linearly modeling life expectancy, the greater the regression slope for a jurisdiction, the faster the increase in life expectancy for that jurisdiction. Linear regression slope was also utilized by the US Census Bureau to compare the growth rates of *LE0* among US states.[7]

For most jurisdictions under comparison in this report, data were only available up to 2003. We chose data points based on a 2:1 ratio between base period and projection period, i.e., using data points from 1989 through 2003 to fit the model and to project *LE0* values and mortality rates from 2004 to 2010.

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