ABSTRACT

Objective: To assess the global position of Canadian life expectancy and to determine the areas of greatest negative impact on life expectancy.

Methods: Using retrospective data on life expectancy at birth (LE0) and age-standardized mortality rates, Canada was compared with 13 other countries with the longest LE0. Linear regression models were used to produce trends and projections of LE0 until 2010.

Results: Canadian women and men currently rank 8th and 5th, respectively, in LE0 among the 14 nations. Canada has one of the smallest annual LE0 improvement rates among the countries studied. Canadian women progressed significantly slower than nine countries and Canadian men progressed slower than five. Women are improving at only half the rate of men due to narrowing gaps in most mortality risks – mostly for cardiovascular diseases, lung cancer and injury. These trends lowered projected LE0 ranks of Canadians, especially for women, for 2010.

Conclusion: LE0 of Canadians is slipping relative to most of the other 13 countries, and more so for women than men. This phenomenon is explained by historically higher mortality rates from ischemic heart disease, cancer and respiratory system disease for all Canadians, coupled with recently lower improvement rates in most mortality risks for Canadian women and in cancers and diabetes for Canadian men. Improving the health and wellness of Canadians, particularly women, demands a priority focus on enhanced chronic disease detection and management as well as strategies to reduce obesity and tobacco use by addressing the determinants of these behavioural risk factors.

Key words: Life expectancy; age-standardized mortality rates; longitudinal trends; regression analysis

Qua: The estimated number of years a newborn can be expected to live given prevailing mortality rates, is a universal indicator for comparing the health status of jurisdictions. It is also a proxy measure of such social conditions as wealth, economic opportunity, health care, and education. For this reason, inequalities in life expectancy usually signal inequities in other social, economic and environmental conditions.

Over the past century, global improvements in public health, medicine, working conditions and nutrition have led to a dramatic increase in life expectancy. In 1921, LE0 for Canadian men and women were only 56.0 and 58.2 years, respectively. By 2003, those corresponding values had increased by about 40% to 77.4 and 82.4 years. Meanwhile, the gap in life expectancy between women and men in Canada increased from 2.2 years in early 1920s to its peak of 7.4 years in late 1970s, and then has been narrowing over the past three decades. In fact, the gender gap in LE0 in most developed nations has become progressively smaller.

We know that Canada is among the world’s leading nations with the longest LE0. However, neither systematic review nor longitudinal analysis of LE0 has ever been conducted to recognize Canada’s strength and weakness relative to other nations. Using annual rankings, improvements rate and projections, this study provides a robust picture of Canada’s global position in LE0. Mortality rate comparisons of major causes of death further help to identify the areas for improvement of life expectancy in Canada.

METHODS

Countries under comparison

Estimates of LE0 are sensitive to population size. To ensure robust trend analyses of LE0 and mortality rates, only those countries with LE0 rankings in the top 10 for either men or women and with populations over 1,000,000 were selected. This resulted in the selection of 14 countries, as listed in Table 1.

Source of data

The 14 countries that met the selection criteria are all members of the Organization for Economic Cooperation and Development (OECD). Age-standardized mortality rates (ASMR)5,6 and LE0 data for all countries were directly obtained from the Health Data 2006 – an annual health report from the OECD. Annual rankings, increment rates and projected values for 2010 for the 14 countries in LE0 were calculated in this study.

Comparisons by disease-specific mortality rates

Since LE0 is a summary number reflecting overall death rates, further examining disease-specific mortality rates behind the LE0 values is crucial to identifying areas for improvement. For each specific mortality risk in a year, the difference in ASMR values between Canada and the best performing country from the other 13 countries was calculated.
To reflect recent trends and establish a reliable basis for projecting life expectancy, statistical analysis was performed to test statistical differences between regression slopes. Using ANCOVA, we first examined the overall difference among the 14 regression slopes and after the overall slope difference was confirmed to be statistically significant, we then simultaneously tested differences of slopes between Canada and each of 13 other countries at both 0.05 and the adjusted significance levels using the most conservative Bonferroni correction. The Bonferroni correction sets alpha value for the entire set of n comparisons equal to α (e.g., 0.05) by taking the alpha value for each comparison equal to α/n (0.05/13 = 0.0039 in our case).

Additionally, point estimates with 95% prediction intervals (PI) for LEo in 2010 were calculated for all countries through linear extrapolation from fitted regression equations, reflecting tendency of LEo progression if present trends continued.

RESULTS
Canada’s position in life expectancy
As shown in Table 1, Canada is among the healthiest nations in the world as measured by LEo. In 2003, Canadian women and men ranked 8th and 5th in LEo, respectively. In recent years, Canadian women whose rank fell from 3rd in 1989 to 8th in 2003 have been losing position relative to women from other leading countries. In contrast, rankings for Canadian men have been steady around 5th place for the same period. The advantage of women over men for LEo in Canada has also been reduced from 7.4 years in the late 1970s to 5.0 years in 2003.
Life expectancy comparison by annual gain

Table 1 also shows that Canada has one of the smallest annual gains in $LE_0$ among the countries studied. After the hypotheses of equal slopes among the 14 countries in both women and men were rejected, our analyses of covariance tested slope differences between Canada and each of 13 other nations simultaneously and statistically confirmed that Canadian women’s annual improvement rate in $LE_0$ (43 days per year) is significantly slower than those for women from 11 countries at a significance level of $\alpha=0.05$ or 9 countries at significance level of $\alpha=0.0039$ (with Bonferroni correction). These nations included Japan [98(p<0.0001)], Austria [87(p<0.0001)], Germany [84(p<0.0001)], Spain [81(p<0.0001)], Italy [80(p<0.0001)], Finland [77(p<0.0001)], Switzerland [76(p<0.0001)], Southern Europe [60(p<0.0001)], France [60(p<0.0001)], Norway[54(p=0.0365)] and Sweden [53(p=0.0443)].

Canadian men also performed below the average, with an estimated annual $LE_0$ gain of 87 days (11th place by point estimate among the 14 countries), which is significantly lower than values for Finland [113(p<0.0001)], Austria [112(p<0.0001)], Switzerland [111(p=0.0001)], Germany [105(p=0.0028)] and Australia [104(p=0.0037)] at $\alpha=0.0369$ and Italy [98(p=0.043)] at $\alpha=0.05$.

Life expectancy comparison by projection to 2010

If current trends continue, Figure 1(a) shows Canadian men are likely to maintain their position alongside men from the other leading nations. By 2010, there is no statistically significant difference between Canadian men [$LE_0$: 79.0(95%PI: 78.5-79.5)] and other countries, except Switzerland [$LE_0$: 80.1(95%PI: 79.6-80.6)]. Also for men, Canada is significantly ahead of five nations: France [$LE_0$: 77.8(95%PI: 77.5-78.0)], Germany [$LE_0$: 77.8(95%PI: 77.3-78.3)], Netherlands [$LE_0$: 77.4(95%PI: 77.0-77.8)], Finland [$LE_0$: 77.4(95%PI: 76.9-77.8)] and Greece [$LE_0$: 77.2(95%PI: 76.7-77.8)].

In contrast, Figure 1(b) shows Canadian women are unlikely to maintain their position. Assuming current trends, Canadian women [$LE_0$: 83.0(95%PI: 82.6-83.5) in 2010] are expected to fall significantly behind six countries: Japan [$LE_0$: 87.2(95%PI: 86.8-87.7)], Spain [$LE_0$: 84.8(95%PI: 84.3-85.2)], Italy [$LE_0$: 84.5(95%PI: 84.0-85.0)], Switzerland [$LE_0$: 84.4(95%PI: 84.1-84.7)], France [$LE_0$: 84.4(95%PI: 84.1-84.7)] and Australia [$LE_0$: 84.2(95%PI: 83.7-84.6)]. By point estimates, though statistically non-significant, Canadian women are also ranked behind Austria (83.5), Sweden (83.5), Finland (83.3) and Germany (83.2).

Comparisons of disease-specific mortality rates

Figure 2 provides clear pictures of temporal variations in ASMR values for some of the healthiest nations relating to cancer and circulatory system disease (CSD) where the fitted lines were obtained from linear regression on log-transformed ASMR over time. Canadian men have made smaller progressions in mortality rates of cancer (Figure 2(a)) and CSD (Figure 2(c)) than men from Switzerland, and those from Australia, Spain and Japan, respectively. Similarly, Canadian women had much higher rates of cancer death among the nations compared and have progressed slower in cancer death reduction than women from Switzerland and Australia (Figure 2(b)). The reduction of CSD mortality rates among Canadian women has been much slower than that of Japanese women (Figure 2(d)).

As shown in Figure 3(a), the ASMR values for Canadian men are close to the best records for all major diseases except ischemic heart disease and lung cancer. In this regard, Canadian men are far behind the healthiest countries, but are rapidly improving.

Figure 3(b) shows that Canadian women are behind the best records in the areas of ischemic heart disease, all cancers (especially lung cancer) and respiratory system diseases. The mortality rate for ischemic heart disease among Canadian women, however, has been continuously improving relative to the foremost records in this study.

Due to strong socio-economic ties, we have also compared $LE_0$ of Canada and the United States and found no statistically significant difference in improvement rates of $LE_0$ between the two countries. However, Canada is about 2.5 years ahead of the United States in $LE_0$ values in recent years.
Figure 2. Gaps in Selected ASMR between Canada and the Overall Leaders

Figure 2(a) - Cancer Mortality in Men

Figure 2(b) - Cancer Mortality in Women

Figure 2(c) - Circulatory System Disease Mortality in Men

Figure 2(d) - Circulatory System Disease Mortality in Women

Figure 3. Position of Canadians Relative to the Best Performing Countries by Mortality Risk

Figure 3(a) - Men

Figure 3(b) - Women
DISCUSSION

While Canada boasts one of the longest-living populations in the world, two trends have been uncovered through this study. First, Canadians, especially women, are experiencing a lower rate of annual life expectancy gain, compared to the other healthiest nations studied. Second, Canadian women are making slower progress in $LE_o$ than their male counterparts.

This study has some limitations. For instance, single-year age- and cause-specific mortality counts were not available for all nations under comparison. Consequently more sophisticated statistical modelling on life tables could not be implemented. Due to the unavailability and incomparability of data, no causal models linking various determinants of health to $LE_o$ could be established for all countries studied.

Nevertheless, our analysis of mortality risks found that the declining position of Canadian women in $LE_o$ is related to historically higher mortality rates and, recently, smaller mortality rate reduction in comparison to other countries in the areas of circulatory system disease and cancer. These mortality risks, in turn, are closely related to the prevalence of obesity, diabetes, and lifestyle factors like tobacco use in the population.

According to the World Health Organization, Canada had the third highest prevalence rate of diabetes in populations aged 20 and above in 2000, among the 14 countries studied. From OECD Health Data, both Canadian women and men aged 15 and over had the 5th highest rate of overweight and obesity (Body-Mass Index (BMI) ≥25 kg/m²) based on 2003 and latest data among the 13 countries, except Australia which had no comparable self-reported data. Obesity rates in Canada have continued to rise from 10% in 1970 to 23% in 2004 (8% to 23% in men; 13% to 22% in women). Obesity is a risk factor for Type 2 diabetes, cardiovascular diseases, some types of cancer and other chronic conditions. Also from OECD data, Canadians had the worst level of sugar consumption and 5th worst total fat and calories intakes among the 14 nations studied – both are risk factors for diabetes and cardiovascular disease.

While ASMR for lung cancer among Canadian women has increased 27.6% between 1988 and 2002, Canadian women also had the highest incidence rate of lung cancer (31.6 per 100,000 population), which is much higher than Norway (18.7 per 100,000), the second highest in 2002. The higher incidence and mortality rates for lung cancer in Canada are partially explained by the relatively higher smoking rates of Canadian women in earlier decades, among the 14 nations.

In conclusion, Canada is one of the healthiest nations in the world. However, the health status of Canadian women is slipping relative to the health status of both women from other leading countries of the world and Canadian men. Improving the health and wellness of Canadians, particularly women, demands a priority focus on enhanced chronic disease detection and management as well as strategies to reduce obesity and tobacco use by addressing the determinants of these behavioural risk factors.

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