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E	use with caution
F	too unreliable to be published

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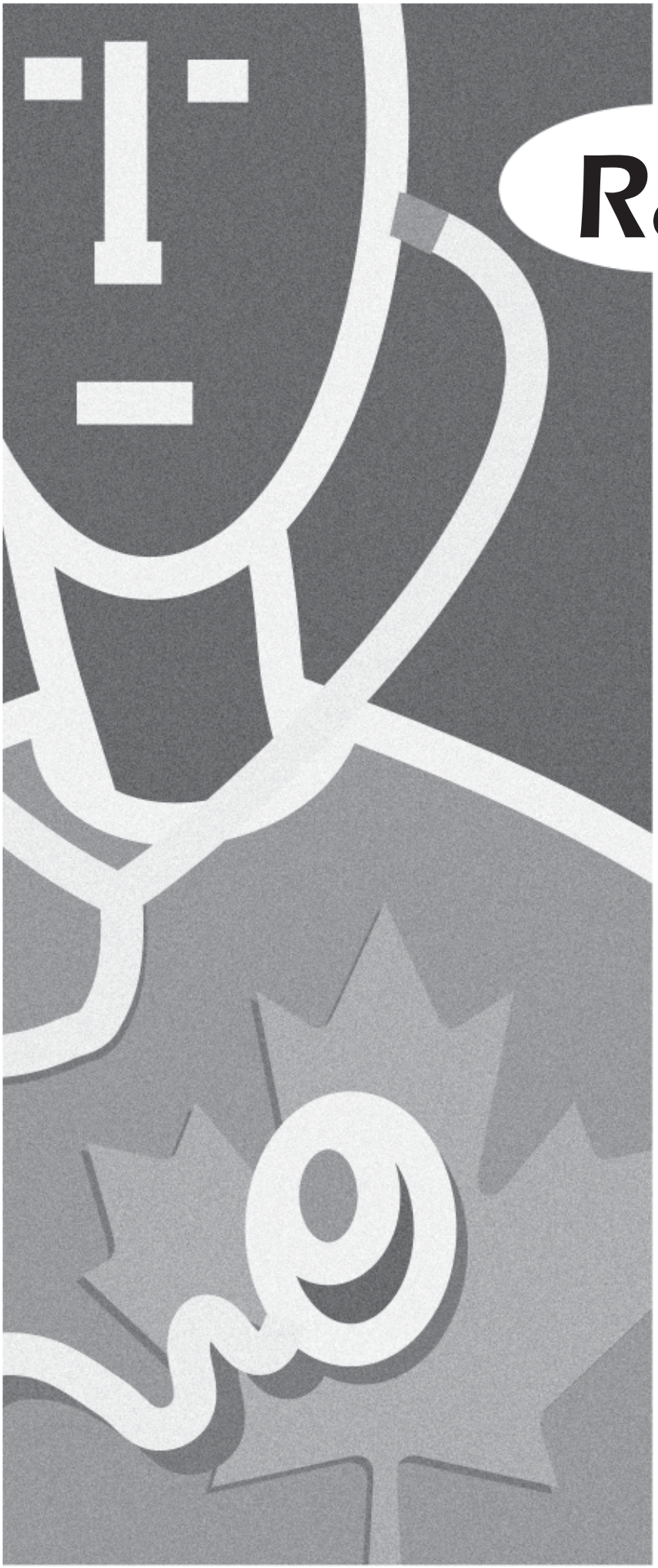

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Suicide in Canada's immigrant population

Éric Caron Malenfant

Abstract

Objectives

This article compares suicide in the immigrant and Canadian-born populations.

Data sources

The suicide data are from the Canadian Vital Statistics Data Base and the World Health Statistics Annual of the World Health Organization. The socio-demographic information used to determine denominators for suicide rates in Canada comes from the Census of Population.

Analytical techniques

Age-standardized suicide rates by sex and place of residence were calculated for the immigrant and Canadian-born populations, as were age- and sex-specific suicide rates. Three-year average rates, centred on census years 1991 and 1996, were used. A weighted data set based on 8 of the top 10 countries of birth for immigrants to Canada was created for international comparisons. Differences between rates were tested for statistical significance.

Main results

Suicide rates for the immigrant population were about half those for the Canadian-born. Among immigrants, suicide rates increase with age; among the Canadian-born, suicide is a "younger" phenomenon. Although male suicide rates exceeded female rates in both populations, the difference was less pronounced among immigrants. The pattern of suicide among immigrants was more like that in their countries of origin than that of the Canadian-born population. Immigrants living in Toronto, Montréal and Vancouver had lower suicide rates than immigrants in other parts of Canada.

Key words

vital statistics, emigration and immigration, ethnic groups, selection bias, urban health, mortality, cause of death

Author

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More than 100 years of research have shown that suicide is not evenly distributed across all population groups. Suicide rates differ between men and women, young and old, the city and the country. Such is also the case for immigrant and native-born populations. In some countries, immigrants, or at least certain groups of immigrants, have higher suicide rates than the native-born population.[1] In other countries, this is not necessarily the case.[2]

A recent study on the subject in Canada reported substantial differences between immigrants and native-born Canadians in the risk of suicide.[3] However, Canada's immigrant population has grown substantially since 1986, the year of the most recent data analyzed in that study. As well, the composition of the immigrant population has changed dramatically: the percentage born in Europe has dropped, and the proportion from Asia has increased appreciably.

Analytical techniques

Before suicide rates were calculated, the immigrant and Canadian-born populations were adjusted for census net undercoverage, and the birthplace of a certain proportion of people who committed suicide was imputed (9%).

Net undercoverage rates by age, sex and place of residence (Canada, Toronto, Montréal, Vancouver) used to adjust the 1991 and 1996 census data are based on information provided by the Reverse Record Check on the net undercoverage of recent immigrants (those who arrived within five years of the census in question). The rates for recent immigrants were used to "correct" the figures for two components of the foreign-born population: recent immigrants and non-permanent residents. The net undercoverage rates for immigrants who arrived more than five years before the census and for the Canadian-born population were used to adjust the other two components of the foreign-born population (non-recent immigrants and native Canadians who were born abroad) and the Canadian-born population. This adjustment accounts for certain differences between the figures in this study and those in previous studies.

Suicides committed by people of unknown origin were distributed by age and sex according to the proportions among those whose birthplaces were known for 1990-1992 and 1995-1997. In strictly relative terms, this method is equivalent to not making any inferences, but in absolute terms, it provides a better estimate of the magnitude of the phenomenon being studied—provided that distributing non-response this way does not introduce bias into the data. Subsequent analyses of the distribution of suicide rates by age, sex and place of residence of cases with unknown birthplace have shown that the vast majority were almost certainly born in Canada and that there was no reason to assume that immigrants were overrepresented in that group.

To smooth out random annual variations created by the small numbers of suicides, three-year average crude rates centred on the census years were calculated. The total number of suicides for each category of age, sex and place of residence for the three years was then divided by three, divided by the corresponding population, and multiplied by 100,000 (Appendix Tables A and B). Since the rates were to be compared with selected World Health Organization (WHO) data, and since the WHO divides the number of suicides by the total population to produce its "aggregate" suicide rates (for all ages combined), the same method was applied here. As a result, the rates in this article differ from those calculated in analyses that relate suicides to the population aged 10 and older or aged 5 and older.

The age-standardized suicide rates were based on the WHO's 2000-2025 projection of the world population's age structure. This standard population was chosen to simplify calculations for international comparisons. Age-standardization has a greater effect on the suicide rates of immigrants than of the Canadian-born, because the immigrant population is older, and unlike the Canadian-born population, immigrants' suicide rates tend to rise with age. Since a young standard population is used, younger age groups (which, in the immigrant population are underrepresented and have low suicide rates) are given a high weight, the result of which is to significantly lower the suicide rates of immigrants.

A data set was created for 8 of the top 10 birthplaces of immigrants to Canada (accounting for nearly half of all immigrants) that provided suicide data to the WHO for the mid-1990s: the United Kingdom, Italy, the United States, Hong Kong, People's Republic of China, Poland, Germany and Portugal. India and the Philippines were excluded owing to lack of data. These data were weighted to make them comparable to data for the immigrants to Canada who had been born there. The international comparisons were made with aggregated data because the numbers of suicides among immigrants from the leading sources were often so low that they were subject to large random variations. The numbers of suicides and suicide rates for immigrants born in these (and other) countries are shown in Appendix Table C.

To assess the extent of random variability of suicide rates and to determine if differences between rates were statistically significant, tests were performed using the method proposed by the National Center for Health Statistics (NCHS) in the United States.[4] For crude suicide rates, the statistical tests differed depending on whether they dealt with rates whose numerator was at least 100 suicides (because the rates were calculated for three-year periods, the numerators are triple the average annual numbers in the tables) or 20 to 99. In the former case, assuming that the sample belonged to an aggregate of samples distributed according to a standard law, the statistical test consisted of ensuring that the difference between the two rates was greater than 1.96 times the standard error of the difference separating them. In the latter case, a Poisson distribution was assumed, confidence intervals were set at 95%, and the rates were considered statistically different if their confidence intervals did not overlap.

The test for standardized suicide rates consisted of ensuring that the 95% confidence intervals of the rates did not overlap. These confidence intervals were set in four stages:

- Calculation of the standard error of the suicide rates of each age group used in the standardization according to the NCHS formulas;
- Calculation of a weighted variance of the rates of each age group used in the standardization: the standard error of the rate of each group was multiplied by the weight of each of these groups in the standard population, then each result was squared;
- Calculation of the standardized standard error of the standardized rate: the square root of the sum of the weighted variance;
- Calculation of 95% confidence intervals: rate +/- 1.96 * the standardized standard error.

To summarize, SR +/- (1.96* sqrt [sum of the squares of (SD*W)]), where SR = standardized rate, SD = standard error of each age group, and W = weight of each age group in the standard population.

This article compares patterns of suicide in Canada's immigrant population with those of the Canadian-born population in 1991 and 1996 (see *Analytical techniques*, *Data sources*, *Definitions* and *Limitations*.) Suicide patterns are examined by sex, age, continent of birth and residence in the three largest urban centres (Toronto, Montréal and Vancouver). International comparisons are presented to put the findings in perspective and to determine if immigrants' suicide rates are closer to rates in their countries of origin or to those of the Canadian-born population.

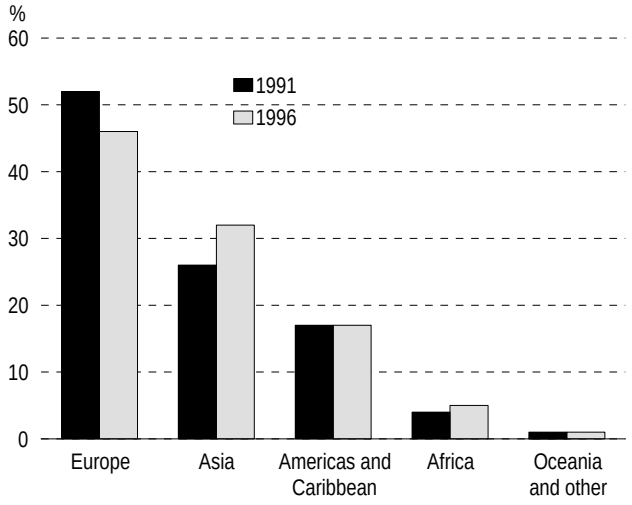
Increasing numbers, shifting origins

In 1996, the foreign-born population numbered more than 5.4 million and made up about 18% of the Canadian population (see *Definitions*). The 1996 figure was a 12% increase from 1991, far surpassing the 4% increase in native-born Canadians during the same period.

Nearly half of the immigrant population was born in Europe (Chart 1). However, Asia accounts for a large proportion of recent immigrants, which has resulted in a decline in the percentage of the immigrant population who were born in Europe.

The immigrant population is older than that of the Canadian-born. Proportionally fewer immigrants are younger than 25, and more are aged 25 or older. This is probably because substantial numbers of immigrants arrive between the ages of 25 and 40. For women, these ages are their prime childbearing years, so many immigrant women will give birth after coming to Canada, and their children will be Canadian-born.

Chart 1
Percentage distribution of immigrant population, by continent of birth, Canada, 1991 and 1996



Data sources: 1991 and 1996 Census of Population

Data sources

Canadian suicide data come from the Canadian Vital Statistics Data Base, which contains information from the vital statistics registry in each province and territory. Maintained by Statistics Canada, this database provides a virtually complete count of all demographic events in Canada. Annual figures are calculated for the calendar year.

Data on suicides in other countries are from the *World Health Statistics Annual*,[5] which presents mortality data by cause, age and sex for reporting states, based on uniform classification of causes of death.

The Census of Population collects information on birthplace every five years from 20% of households. All other socio-demographic data needed to determine the denominators for suicide rates among immigrants living in Canada are also from the census (age, sex, place of residence, non-permanent resident status and year of immigration).

The Reverse Record Check (RRC) is conducted after every census to assess the quality of coverage by estimating the number of people who were missed (undercoverage) or who were counted more than once (overcoverage). This analysis used RRC data to "correct" population counts for undercoverage according to selected characteristics.

Less likely to commit suicide

Suicide is a relatively rare case of death (less than 4,000 deaths a year), compared with leading causes such as cancer (nearly 60,000 per year). And as a proportion of all deaths, suicide accounts for less than 2%. Nevertheless, it is a serious problem because of the suffering it entails for the individual and the grief it inflicts on family and friends. Between 1995 and 1997, there was an average of 3,863 suicides a year in Canada, or 13 per 100,000 population. Of that number, 3,054 were males and

809 were females; the corresponding crude suicide rates were 21.0 and 5.5 per 100,000.

Immigrants are much less likely than native-born Canadians to commit suicide. Of the annual average from 1995 to 1997, 535 suicides were committed by immigrants and 3,328 by people born in Canada (Appendix Table A). These numbers translate into crude rates of 9.9 and 13.9 per 100,000, respectively. When these rates are age-standardized, the rate for immigrants is almost half that for the Canadian-born: 7.9 versus 13.3 per 100,000 (Table 1, Appendix Table B). The difference prevails among males and females, and in both periods: 1990-1992 and 1995-1997.

Regardless of their continent of birth, immigrants' age-standardized suicide rates are low, compared with the Canadian-born population (Appendix Table C). Nonetheless, immigrant rates vary considerably by birthplace. People born in Oceania (Australia, New Zealand, Pacific islands) and Europe have relatively high crude suicide rates, whereas those from Africa and Asia have the lowest (both sexes combined).

A number of explanations could be proposed to account for the low suicide rates among immigrants. First, the tightly knit nature of certain immigrant communities may help protect their members against suicide.[3] Second, suicidal behaviour may result from cultural traits acquired in socialization that begins early in life. According to this "cultural" hypothesis and other studies in other countries,[3] immigrants' suicide rates should be closer to rates in their countries of origin than to those of native-born Canadians. Third, a "selection effect" may be influencing the immigrant population's suicide rates; specifically, immigrants are selected based on criteria related to their physical and mental health.[7-10]

The suicide rates for immigrants from 8 of Canada's 10 leading sources of immigration and the rates in their birthplace differ significantly from those of native-born Canadians for the two sexes combined (the differences are also significant for men, but not for women) (Table 2). Thus, in agreement with the "cultural" hypothesis,

Table 1
Age-standardized† suicide rates for immigrants and Canadian-born population, by sex, Canada, 1990-1992 and 1995-1997

	Both sexes		Males		Females	
	Immigrant	Born in Canada	Immigrant	Born in Canada	Immigrant	Born in Canada
	Suicides per 100,000					
1990-1992	8.3*	13.0	12.6*	21.0	4.2*	5.1
1995-1997	7.9*	13.3	12.0*	21.6	4.0*	5.3

Data sources: Canadian Vital Statistics Data Base; 1991 and 1996 Census of Population
† Age-standardized to new world population standard (for 2000 to 2025)
** Significantly different from rate for Canadian-born population (p < 0.05)*

Definitions

For this analysis, *suicide* is defined as any death coded E950 to E959 (suicide and self-inflicted injury) according to the *International Classification of Diseases, Ninth Revision* (ICD-9).[6]

The terms *immigrant*, *foreign-born*, and *born outside Canada* are all used to refer to the same concept—people born outside Canada's borders—whether the parents are Canadian or foreign. Because the Canadian Vital Statistics Data Base contains no information about citizenship, deaths were classified by birthplace alone. The immigrant population actually consists of three distinct groups: true immigrants, non-permanent residents, and people born as Canadian citizens outside Canada's borders (because one or both parents are Canadian). *Canadian-born* refers to anyone born within Canada's borders, and so includes children of non-citizens (foreigners travelling in Canada, asylum seekers, etc.).

A *census metropolitan area* consists of an "urban core" with a population of at least 100,000 based on the previous census, plus adjacent urban and rural areas that have a high degree of social and economic integration with the core.

Table 2
Age-standardized† suicide rates for immigrants from 8 of 10 leading sources, populations in those 8 sources and Canadian-born population, by sex, mid-1990s

	Both sexes	Males	Females
	Suicides per 100,000		
Immigrants from 8 of 10 leading sources‡	8.8*	12.9*	4.9
Population in those 8 sources combined‡	9.2*	13.4*	5.3
Born in Canada	13.3	21.6	5.3

Data sources: Canadian Vital Statistics Data Base; 1996 Census of Population; World Health Organization
† Age-standardized to new world population standard (for 2000 to 2025)
‡ United Kingdom, Italy, United States, Hong Kong, People's Republic of China, Poland, Germany, Portugal
** Significantly different from rate for Canadian-born population (p < 0.05)*

immigrants' suicide rates are closer to the rates in their birthplace than to those of the Canadian-born population.

This does not mean that native-born Canadians have an exceptionally high suicide rate. Even though the rate exceeds the aggregate age-standardized rate for all countries that reported to the World Health Organization, several European countries had higher rates in 1996: Russia, Hungary, Finland, Austria and France.

Difference between sexes less pronounced

Although researchers generally agree that women attempt suicide more often than men,[11,12] men actually take their own lives much more often than women. (Of the countries reporting to the World Health Organization in the late 1990s, the only exception to the higher suicide rate among males was in China.) However, the extent of the difference in male and female suicide rates varies.

In Canada, the gap between male and female suicide rates is wider in the Canadian-born than in the immigrant population. In the 1995-1997 period, the suicide rates of Canadian-born males were four times those of females, whereas the rates for male immigrants were "only" three times the female rates (Table 1). This also applies to the 1990-1992 period, and similar observations were made in previous studies.[13]

The male-to-female suicide ratio was 2.7 for immigrants from the 8 (of 10) leading sources, 2.5 in those countries of origin combined, and 4.1 for native-born Canadians. Thus, the male-to-female suicide ratio for the immigrant population is closer to that in their birthplace than to that of the Canadian-born population.

Cultural definitions of gender roles and the varied conditions in which men and women live in different societies may account for these findings. However, analysis of such factors is beyond the scope of this study.

Risk increases with age

While media attention tends to focus on suicides among young people, in most countries, suicide rates rise with age. Canada is an exception in that among the Canadian-born, the risk of suicide peaks at ages 35 to 44, then declines and levels off (Table 3). This overall pattern generally resembles that for Canadian-born males. For Canadian-born females, the picture is somewhat different: their suicide rate peaks at ages 45 to 54 and then falls at older ages.

By contrast, the suicide rate among immigrants increases almost steadily with age—the highest rates are among the elderly (17.9 per 100,000 for people aged 75 or older in 1995-1997). This is true for male immigrants and, to some extent, for female immigrants, although female rates level off after age 55. These patterns in age-specific suicide rates prevailed in 1995-1997 and 1990-1992 (Appendix Table B) and echoed the results of earlier analyses.[13]

The pattern of age-specific suicide rates for immigrants, especially males, is similar to the world pattern as reported to the World Health Organization for 1995, increasing with age among both sexes (Chart 2). Factors that might explain why elderly people would be more likely than young people to take their own lives include isolation, physical and mental illness, deaths of loved ones, and possibly, a feeling of uselessness.[14] The literature

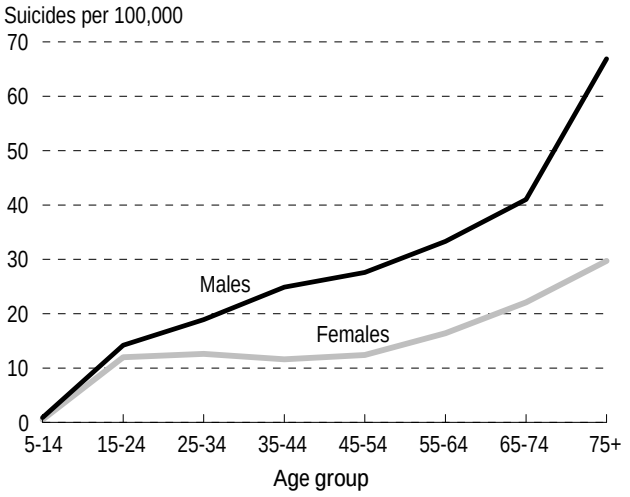
Table 3
Suicide rates for immigrants and Canadian-born population, by sex and age group, Canada, 1995-1997

	Both sexes		Males		Females	
	Immigrant	Born in Canada	Immigrant	Born in Canada	Immigrant	Born in Canada
	Suicides per 100,000					
Crude	9.9	13.9	15.0	22.3	5.0	5.6
Age-standardized†	7.9*	13.3	12.0*	21.6	4.0*	5.3
5-14	0.7‡	1.2	0.9‡	1.6	0.5‡	0.7
15-24	6.8*	15.6	10.1*	25.7	3.5	4.9
25-34	7.8*	18.3	12.3*	29.9	3.5*	6.4
35-44	9.2*	21.5	14.4*	33.3	4.3*	9.6
45-54	11.7*	21.0	18.0*	31.5	5.3*	10.5
55-64	11.7*	15.7	15.6*	25.5	7.7	6.3
65-74	12.7	13.1	18.8*	23.4	7.3*	4.6
75+	17.9	14.0	32.9	30.6	7.7*	3.7

Data sources: Canadian Vital Statistics Data Base; 1996 Census of Population
† Age-standardized to new world population standard (for 2000 to 2025)
‡ Too few cases to test for significance
** Significantly different from rate for Canadian-born population ($p < 0.05$)*

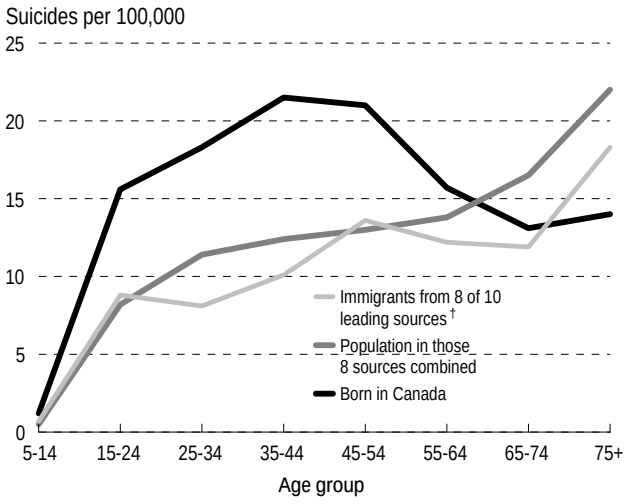
suggests that the social interpretation of various stages of life is relative.[15] This might contribute to explaining age differences in suicide rates between the immigrant and Canadian-born populations.

Chart 2
Suicide rates for all countries reporting to World Health Organization, by age group and sex, 1995



Data source: World Health Organization

Chart 3
Suicide rates for immigrants from 8 of 10 leading sources, populations in those 8 sources and Canadian-born population, by age group, mid-1990s



Data sources: Canadian Vital Statistics Data Base; 1996 Census of Population; World Health Organization
† United Kingdom, Italy, United States, Hong Kong, People's Republic of China, Poland, Germany, Portugal

However, these issues are beyond what can be analyzed in this study.

For immigrants from the eight leading sources, the pattern of age-specific suicide rates differs somewhat from that in their birthplace: rates increase with age, but in steps, not steadily, and dip slightly from ages 55 to 74 (Chart 3). Nonetheless, the overall pattern is closer to that in their birthplace than to that of the Canadian-born population.

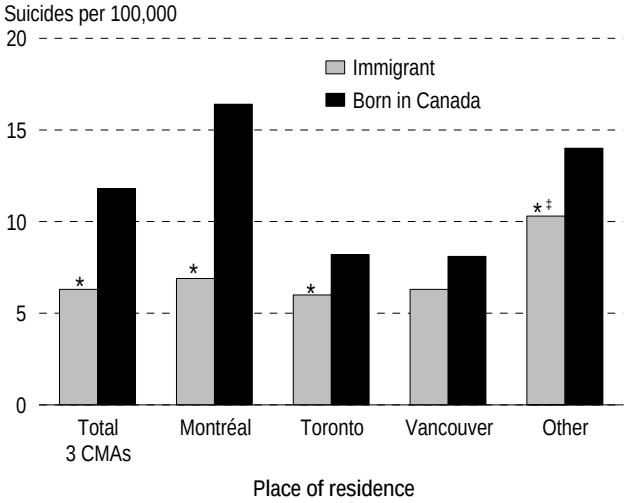
Living in Toronto, Montréal and Vancouver "protective"

Canada's immigrant population is concentrated in large urban areas. In 1996, over 80% of immigrants lived in 1 of the 25 census metropolitan areas (CMAs), compared with about 60% of the Canadian-born population. More than 60% of immigrants were in Toronto, Montréal or Vancouver (versus 27% of the Canadian-born), and Toronto alone was home to nearly 2 million foreign-born people, more than 35% of Canada's immigrants. Almost a third of the combined populations of these three cities were born outside the country, and the addition of their children would make this proportion much higher.

Suicide is even less prevalent among immigrants in Toronto, Montréal and Vancouver than among those elsewhere in Canada (Chart 4). In the 1995-1997 period, the age-standardized suicide rate was 6.3 per 100,000 for immigrants in the three CMAs combined, whereas the rate for immigrants living elsewhere was almost double at 10.3. In addition, the suicide rates for immigrants are similar in each city. The presence of ethnic communities in these cities may have something to do with the relatively low rates. The observation made by Émile Durkheim over 100 years ago may apply here: "Suicide varies in inverse proportion to the degree of integration of the social group to which the individual belongs."[16]

The "protective" urban effect does not extend to the Canadian-born population in the three cities overall, although it would if Montréal were left out. The suicide rates for native-born Canadians in Toronto, Montréal and Vancouver reflect the situation in their respective provinces. According

Chart 4
Age-standardized† suicide rates for immigrants and Canadian-born population, by place of residence, Canada, 1995-1997



Data sources: Canadian Vital Statistics Data Base; 1996 Census of Population
† Age-standardized to new world population standard (for 2000 to 2025)
‡ Significantly different from rate for immigrants in Montréal, Toronto and Vancouver ($p < 0.05$)
** Significantly different from rate for Canadian-born population ($p < 0.05$)*

to a recent study,[12] Ontario and British Columbia have suicide rates below the national average, and Québec has the highest provincial rate. Accordingly, age-standardized rates are lower for Canadian-born people in the Vancouver and Toronto metropolitan areas than outside them, and there is little difference between the two cities. On the other hand, the rate for the Canadian-born population in Montréal is disproportionately high.

Concluding remarks

Patterns of suicide among immigrants differ from those of the Canadian-born population. Immigrants, both men and women, are less likely to commit suicide. In addition, although more men than women take their own lives, the gap is narrower among immigrants. For people born outside Canada, suicide rates increase with age, as is typically the case in other countries; for the Canadian-born, suicide appears to be a "younger" phenomenon.

The overall pattern of suicide among immigrants was closer to that of their birthplace than to that of the Canadian-born population. However, more detailed international comparisons covering more countries and different periods are needed to corroborate and refine these conclusions.

Immigrants in Toronto, Montréal and Vancouver seem to have some additional "protection" against suicide. This suggests that, aside from a possible selection effect, the environment in which immigrants settle could affect their suicide rates. It is possible that there may be greater social integration of newcomers in areas with large immigrant communities. ●

Limitations

The study applies only to census years (1991 and 1996), and analysis was limited by the small number of suicides committed by immigrants (about 500 a year).

The populations used in the denominators of suicide rates exclude residents of institutions, because the census form for institutions has no questions on birthplace.

Since some suicides are probably reported as accidental deaths or deaths of unknown cause, the figures presented here may be underestimates. On the other hand, the concept of death by "self-inflicted injury" in the *International Classification of Diseases, Ninth Revision*[6] may overstate the number of suicides by counting people who killed themselves unintentionally.

International comparisons of suicide rates must be interpreted with caution. In principle, all reporting countries employ the same system for classifying deaths, but only limited comparisons can be made with the figures collected by the World Health Organization, owing to differences in suicide recording methods, in coverage, and in the population count used as the denominator for calculating rates. And although it simplifies comparisons and allows the results to be put in perspective, the method used to create the weighted data set for the group of 8 leading sources of immigrants is not perfect (notably, Europe is overrepresented).

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Appendix

Table A
Average annual number of suicides, immigrants and Canadian-born population, by sex and age group, Canada, 1990-1992 and 1995-1997

	Immigrant						Born in Canada					
	Both sexes		Males		Females		Both sexes		Males		Females	
	1990-1992	1995-1997	1990-1992	1995-1997	1990-1992	1995-1997	1990-1992	1995-1997	1990-1992	1995-1997	1990-1992	1995-1997
Total	497	535	369	395	128	140	3,063	3,328	2,455	2,659	608	669
5-14	2	2	2	1	0	1	29	43	21	30	8	13
15-24	36	36	27	27	9	9	569	543	482	460	87	83
25-34	73	74	55	57	18	17	808	701	663	579	144	121
35-44	90	94	69	71	21	23	676	848	519	660	157	188
45-54	88	113	61	87	27	26	401	585	310	438	91	148
55-64	80	82	64	55	16	27	283	285	223	227	61	58
65-74	61	74	39	52	22	22	189	192	147	156	43	37
75+	67	61	51	45	16	15	107	130	90	109	17	21

Data source: Canadian Vital Statistics Data Base
Note: Four Canadian-born suicides were excluded because of missing information. For 1990-1992, age and birthplace of 2 suicides were unknown; and for 1995-1997, age and sex of 2 suicides were unknown. Because of rounding, detail may not add to totals.

Table B
Suicide rates for immigrants and Canadian-born population, by sex and age group, Canada, 1990-1992 and 1995-1997

	Both sexes		Males		Females	
	Immigrant	Born in Canada	Immigrant	Born in Canada	Immigrant	Born in Canada
	Suicides per 100,000					
1990-1992						
Crude	9.5	13.5	14.3	21.8	4.8	5.4
Age-standardized†	7.3*	13.1	11.1*	21.3	3.7*	5.2
5-14	0.7	0.8	1.3	1.2	0.0	0.5
15-24	5.4	16.4	7.8	27.2	2.9	5.2
25-34	6.9	19.4	10.7	31.5	3.1	7.1
35-44	8.6	19.6	13.4	30.0	3.9	9.1
45-54	10.8	18.2	14.8	28.1	6.7	8.3
55-64	12.3	16.1	19.2	26.1	5.1	6.6
65-74	12.5	13.7	17.1	23.6	8.5	5.6
75+	20.9	13.9	39.4	30.1	8.1	3.7
1995-1997						
Crude	9.9	13.9	15.0	22.3	5.0	5.6
Age-standardized†	7.9*	13.3	12.0*	21.6	4.0*	5.3
5-14	0.7	1.2	0.9	1.6	0.5	0.7
15-24	6.8	15.6	10.1	25.7	3.5	4.9
25-34	7.8	18.3	12.3	29.9	3.5	6.4
35-44	9.2	21.5	14.4	33.3	4.3	9.6
45-54	11.7	21.0	18.0	31.5	5.3	10.5
55-64	11.7	15.7	15.6	25.5	7.7	6.3
65-74	12.7	13.1	18.8	23.4	7.3	4.6
75+	17.9	14.0	32.9	30.6	7.7	3.7

Data sources: Canadian Vital Statistics Data Base; 1991 and 1996 Census of Population
Note: Four Canadian-born suicides were excluded because of missing information. For 1990-1992, age and birthplace of 2 suicides were unknown; and for 1995-1997, age and sex of 2 suicides were unknown.
† Age-standardized to new world population standard (for 2000 to 2025)
** Significantly different from rate for Canadian-born population ($p < 0.05$)*

Table C
Average annual number of suicides and crude suicide rates for immigrants, by birthplace, Canada, 1995-1997

Birthplace	Average annual number	Crude rate	Age-standardized rate†
		Suicides per 100,000	
Canada	3,328	13.9	13.3
Outside Canada	535	9.9	7.9
Europe	353	14.3	10.9
Poland	38	18.9	...
Germany	37	18.3	...
United Kingdom	86	12.5	...
Italy	34	9.8	...
Portugal	14	8.1	...
Other Europe	145	16.7	...
Oceania‡ and other	6	12.2	...
Americas and Caribbean	62	6.9	6.0
United States	31	10.8	...
Central/South America	18	5.7	...
Caribbean and Bermuda	13	4.3	...
Africa	16	6.1	...
Asia	98	5.6	5.3
India	18	7.1	...
People's Republic of China	22	8.7	...
Western/Central Asia and Middle East	11	4.8	...
Hong Kong	10	3.7	...
Philippines	7	3.6	...
Other Asia	29	5.6	...

Data sources: Canadian Vital Statistics Data Base; 1996 Census of Population
Notes: Two Canadian-born suicides were excluded because age was unknown. Because of small numbers, variability of age-standardized rates by country and continent of birth could be calculated only for Canada, Europe, Americas and Caribbean, and Asia.
† Age-standardized to new world population standard (for 2000 to 2025)
‡ Australia, New Zealand, Pacific islands
... Data not available


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Leading cancers—changes in five-year relative survival

Larry F. Ellison and Laurie Gibbons

Abstract

Objectives

Changes in five-year relative survival ratios for prostate, breast, colorectal and lung cancer cases are examined. Ratios for cases diagnosed in the 1985-1987 period are compared with those for 1992-1994. Incidence and mortality rates between 1985 and 1999 are compared with changes in relative survival.

Data sources

Data are from the Canadian Cancer Registry, the National Cancer Incidence Reporting System, the Canadian Mortality Data Base, and life tables.

Analytical techniques

Analysis was conducted using the maximum likelihood method of Estève. Age-standardized ratios for a given cancer were calculated by weighting age-specific ratios to the age distribution of patients diagnosed with that cancer. Statistical tests were used to compare corresponding age-specific and age-standardized ratios across the two periods. National estimates exclude Québec and New Brunswick.

Main results

Between the 1985-1987 period and the 1992-1994 period, increases in five-year age-standardized relative survival ratios were dramatic for prostate cancer, large for breast cancer, and somewhat smaller for colorectal cancer. There was little absolute change in the ratios for lung cancer.

Key words

survival analysis, survival rate/ratios

Authors

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Over the last several decades, there have been some major changes in the early detection, diagnosis and treatment of cancer.[1] A cancer patient's prognosis is influenced by several factors. Some are inherent personal characteristics that cannot be modified, such as age, sex and ethnicity. Others relate to early diagnosis and treatment, which can affect the course of the disease.

Cancer control programs attempt to reduce the burden of the disease. At the population level, this means reducing the number of new cases and deaths; short-term measures include improving survival and the quality of life of individual patients.[2] Because population-based survival estimates are based on the experiences of a highly heterogeneous group of people, they are useful "average" outcome indicators of the efficiency of efforts related to early diagnosis and treatment of cancer, and they can be used for comparisons between populations or over time.[3]

Methods

Data sources

Cancer case data were obtained from two different sources: the Canadian Cancer Registry (CCR), a dynamic, person-oriented database containing cases diagnosed from 1992 onward, and its predecessor, the National Cancer Incidence Reporting System (NCIRS), a fixed, tumour-oriented database containing cases as far back as 1969. These databases are maintained by Statistics Canada and contain information based on reports from every provincial/territorial cancer registry. Mortality data are from the Canadian Mortality Data Base (also maintained by Statistics Canada), which is based on information provided by the vital statistics registrars in each province and territory. Canadian and provincial life tables from Statistics Canada were also used.

Analytical techniques

Two separate files were created. The first included all invasive cancer cases diagnosed between 1992 and 1994 and reported to the CCR as of September 2002; the second, all invasive cancer cases diagnosed between 1985 and 1987 and reported to the NCIRS. Three-year periods were chosen to ensure more stable and hence more comparable survival estimates than would have resulted from single-year estimates (for example, 1985 and 1994). Invasive cancer cases were defined using the *International Classification of Diseases, Ninth Edition* codes 140 to 208 (excluding code 173, non-melanoma skin cancer).[4] Historically, coding practices for cases coded to 233.7, in situ bladder, were inconsistent; therefore, such cases were considered to be potentially invasive and were also included.

Vital status during the first five years was determined through record linkage to the Canadian Mortality Data Base, or from information reported by provincial/territorial cancer registries. For deaths reported by a provincial registry but not confirmed by record linkage, it was assumed that the individual died on the date submitted by the reporting province. Such cases represented 0.6% (302 of 53,298) and 0.6% (369 of 61,597) of the total number of deaths to eligible subjects diagnosed between 1985 and 1987, and between 1992 and 1994, respectively. Although computerized record linkage for follow-up precludes a definitive answer about the completeness of mortality tracing, computerized record linkage has been shown to be comparable with, or even superior to, active follow-up.[5]

If a patient had been diagnosed with more than one invasive tumour in either of the files, only the record with the earliest date of diagnosis was retained for analysis. Records for individuals who had been diagnosed with a primary invasive cancer before 1985 or before 1992 were excluded from the 1985-1987 and 1992-1994 analyses, respectively. Historical information (1969 to 1991) for cases diagnosed in 1992-1994 was obtained by linking the CCR data with the NCIRS database. For Ontario, the provincial tumour sequence number was used to determine if an individual had been diagnosed with a primary invasive tumour before 1992. Historic information (1969 to 1984) for cases diagnosed between 1985 and 1987, including those from Ontario, was obtained in a similar manner to that used for the 1992-1994 data.

The analyses were restricted to prostate (ICD-9 code 185), female breast (174), colorectal (153 and 154) and lung cancer (162) cases. Records were excluded when: the year of birth or death was unknown; individuals were younger than 15 or older than 99 when diagnosed; cancer registration was established either through autopsy or death certificate only (DCO); the date of cancer registration was after the date of death (a negative survival time). In both analyses, most exclusions were autopsy or DCO cases (Appendix Tables A through D). When information on day/month of diagnosis and/or day/month of death was missing, survival time was estimated.[6] The percentage of such records was greater in the earlier period (5.0% in 1985-1987 versus 3.4% in 1992-1994).

Both analyses were conducted in STATA 6.0 using the strel module,[2] a user-written module that follows Estève's maximum likelihood method.[7] Cases with the same date of diagnosis and death (not including those previously excluded because they were diagnosed through autopsy or DCO) were assigned one day of survival,[6] as the program automatically excludes cases with zero days of survival. Deaths were grouped into intervals following the actuarial method for survival analysis as follows: 3-month intervals for the first year of follow-up, then 6-month intervals for the remaining 4 years, for a total of 12 intervals. More intervals were used in the first year of follow-up because the actuarial method assumes an approximately even distribution of deaths within each interval, and mortality is often highest during the first year.

To estimate relative survival, observed and expected survival proportions must be compared. The expected survival proportions used to calculate national and provincial relative survival ratios were derived, by single-year-of-age, from sex-specific provincial life tables published by Statistics Canada.[8-10] As only the 1995-1997 life tables were developed up to age 99, the 1985-1987 and 1990-1992 sets of life tables were extended from age 85 to 99 using a method suggested by Dickman et al.[11] The life table deployed was dependent on the year of diagnosis; for example, the survival of cases diagnosed in 1994 was compared with the 1995-1997 life table.

Age-standardized relative survival ratios for a given cancer were calculated by weighting age-specific ratios to the age distribution of patients diagnosed with that cancer. The standard population used by Ellison and Gibbons[6] was selected as the basis to calculate age-standardized estimates. The age-standardized prostate cancer estimate for Prince Edward Island for the 1985-1987 period was calculated as the weighted average of the relative survival ratios of the oldest four age groups, as there were no eligible prostate cancer cases in the youngest age group in this province during this period. Confidence intervals for age-standardized estimates were based on the log (-log) transformation. Non-standardized provincial ratios for each of the four major cancer sites were also calculated (Appendix Table E).

Five-year age-standardized relative survival ratios derived from cases diagnosed in the 1985-1987 period were compared with corresponding ratios derived from cases diagnosed in 1992-1994 using a statistical test,[12] which was conducted on the log (-log) scale. This test considers that the difference of the two survival ratios divided by the square root of the sum of their variances follows an approximately normal distribution.

Trends in cancer survival rates provide information on the extent to which changes in early diagnosis and treatment have improved patients' survival and may reflect the extent to which these services have become available to the population.[2] Comparison of survival estimates can also help identify priorities and indicate measures to improve patients' survival.[13]

Several studies of European populations have examined cancer survival rates over time to assess the impact of changes in diagnosis and treatment.[2,11,14] A recent Canadian report examined five-year relative survival among individuals diagnosed with prostate, breast, colorectal and lung cancer.[6] While this paper provided the first Canadian estimates of five-year relative survival, assessing the changes in diagnosis and treatment over time is better studied by comparing cancer survival to a historical baseline.

This analysis compares the five-year relative survival experience of prostate, breast, colorectal and lung cancer cases that were diagnosed in the 1985-1987 period with those diagnosed in 1992-1994. At the time of analysis, these periods were the most recent for which comparable five-year national survival estimates could be calculated (see *Methods* and *Limitations*). The cancer sites chosen for analysis are the four most commonly diagnosed in Canada. Comparisons are presented for age-specific national (excluding Québec and New Brunswick) and age-standardized provincial estimates. Incidence and mortality rates from 1980 to 1999 are also examined to assess the nature of the changes in relative survival over time.

Rise in prostate cancer survival—all provinces, all age groups

The age-standardized five-year relative survival ratio for prostate cancer increased dramatically, rising from 73% for men diagnosed in 1985-1987 to 89% for those who were diagnosed in 1992-1994 (Table 1). Increases were seen in all provinces, and in all age groups.

Table 1
Five-year relative survival ratios for prostate cancer cases diagnosed in 1985-1987 and in 1992-1994, by province† (age-standardized‡) and by age group

	Prostate cancer diagnosed in:								
	1985-1987				1992-1994				
	Relative survival ratio	95% confidence interval	Number of cases	Number of deaths§	Relative survival ratio	95% confidence interval	Number of cases	Number of deaths§	Comparison of relative survival ratios
	%				%				p-value
Canada†‡	73	72, 74	17,588	8,371	89*	88, 89	34,933	10,995	0.000
Newfoundland	62	54, 69	296	166	81*	74, 86	517	196	0.000
Prince Edward Island	58	46, 68	113	66	79*	71, 85	304	105	0.001
Nova Scotia	70	65, 74	805	407	87*	83, 90	1,580	543	0.000
Ontario	72	70, 73	8,368	4,135	88*	87, 89	16,898	5,413	0.000
Manitoba	70	66, 74	1,227	620	91*	88, 94	2,569	788	0.000
Saskatchewan	68	64, 71	1,177	604	87*	84, 90	2,065	689	0.000
Alberta	75	72, 78	1,912	864	83*	81, 85	3,592	1,255	0.000
British Columbia	79	77, 81	3,687	1,507	92*	90, 93	7,379	1,998	0.000
Age group									
15-99	74	73, 75	17,588	8,371	90	90, 91	34,933	10,995	
15-54	70	64, 75	322	105	86*	83, 88	956	161	0.000
55-64	76	74, 77	2,822	885	91*	90, 92	6,545	1,045	0.000
65-74	76	74, 77	7,001	2,767	93*	92, 94	15,382	3,625	0.000
75-84	71	69, 73	5,847	3,332	86*	85, 88	9,925	4,566	0.000
85-99	59	53, 65	1,596	1,282	70*	64, 74	2,125	1,598	0.003

Data sources: National Cancer Incidence Reporting System (1985 to 1987); Canadian Cancer Registry (1992 to 1994); Canadian Vital Statistics Database
† Excluding Québec and New Brunswick. Results for the Yukon and Northwest Territories are not shown because of an insufficient number of cases, but cases from these areas are included in the analysis for Canada.
‡ Age-standardized to 1992 Canadian case distribution for prostate cancer (Reference 6)
§ Within first five years of follow-up
** Significantly different from 1985-1987 ratio ($p \leq 0.05$)*

Limitations

A national (excluding Québec) internal record linkage is regularly performed on the Canadian Cancer Registry (CCR) data to identify and delete duplicate records. This process could only be done on a regional basis for the National Cancer Incidence Reporting System (NCIRS) data; therefore, it is possible that duplicate records may exist in two different regions. However, no evidence suggests that such cases would overrepresent either higher or lower survival cases and hence skew the survival distribution. It is also unlikely that the additional cases resulted in tighter confidence intervals of survival estimates, because the percentage of duplicates found within regions was quite small and would likely be considerably smaller across regions. It is possible that a person identified as having cancer in one region could previously have been diagnosed with a primary cancer in another region, but was not identified as such and was therefore included in the analysis. But CCR data indicate that subjects diagnosed with an invasive cancer in more than one province are rare, even among those with more than one invasive cancer.

Differences in completeness and availability of linkage variables precluded an identical record linkage of cases to deaths for both the NCIRS and CCR data. However, every effort was made to conduct the processes in a similar manner. For example, linkage thresholds were set so that the probabilities of false positive linkages of cases to deaths and missed linkages to deaths were similar for both time periods.

While the NCIRS contains information on cancer incidence from as far back as 1969, data quality issues before 1985 precluded an earlier national, or near-national, survival analysis comparable to that conducted using CCR data. Therefore, the 1985-1987 period was chosen as the baseline.

New Brunswick was excluded from comparisons of survival ratios. Missing values for key record linkage variables among cases diagnosed in that province between 1985 and 1987 did not permit an accurate linkage to the national mortality database, thus preventing a worthwhile survival analysis. Québec data were not analyzed because of problems with record linkage and because the province's method of ascertaining the date of diagnosis differs considerably from that of other provincial cancer registries.

Results for the territories are not shown because of an insufficient number of cases for analysis; cases are, however, included in the national estimates. Expected survival ratios for Prince Edward Island, the Yukon and Northwest Territories in both periods were derived from the Canadian life tables, as stable estimates for single ages could not be produced because of small populations. This substitution should not introduce bias in national estimates, as these three areas combined accounted for 0.9% and 0.8% of all eligible cases in the 1992-1994 and 1985-1987 periods, respectively.

A previously established convention to retrospectively identify death certificate only (DCO) cases in the NCIRS, based on the original method of diagnosis, the source of registration, and the reporting province, was followed. This was necessary because the NCIRS did not include DCO as an option for method of diagnosis. While the convention is considered fairly rigorous, some misclassification of DCO and non-DCO cases is possible. DCO cases were excluded from relative survival analyses because the date of diagnosis, and hence survival time, was unknown. The "true" survival of cases registered by DCO is generally less favourable than that of those in the registry population.[14] The need to exclude DCO cases may have led to increases in relative survival ratios, particularly in provinces with relatively more DCO cases. The magnitude of such increases, however, is generally minor.[14]

In the context of cancer, relative survival is defined as the ratio of the observed survival for a group of cancer patients to the survival that would have been expected for members of the general population assumed to be practically free of that cancer, who have the same main characteristics associated with survival (for example, sex, age, area of residence) as the cancer patients.[15] Ideally, lung cancer patients would also be matched by smoking status to members of the general population, because most lung cancer patients are smokers or ex-smokers and smoking is known to reduce life expectancy. However, life tables by smoking status were not available. While lung cancer relative survival ratios would likely have been higher if life tables by smoking status were available, a previous study found that adjusting the expected survival for the excess mortality related to smoking increased estimates of relative survival by 1% or less.[15]

Stage of disease at diagnosis is not available in the CCR; therefore, the effectiveness and use of early cancer detection from stage-specific survival estimates cannot be investigated. Until staging information is available at a national level, inferences can only be made about the possible effects of diagnosis and treatment together.

The statistical comparisons of age-standardized five-year relative survival ratios, both provincially and nationally across two time periods, were not adjusted for multiple comparisons.

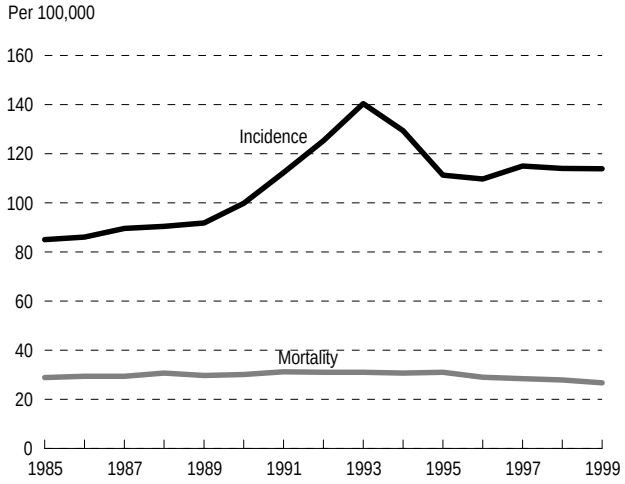
Relative survival for prostate cancer continued to be lower among older and younger men. In both periods, relative survival was lower among 15-to-54-year-olds than among men in the next two older age groups. Other studies have indicated that younger men with this cancer have poorer survival,[16,17] perhaps because of the type of tumours that present in younger men.[17] The smallest absolute increase in relative survival, 11%, was seen in the 85-99 age group.

Provincial increases in relative survival, all of which were statistically significant, ranged from absolute increases of 8% in Alberta to 21% in both Manitoba and Prince Edward Island. Compared with the rest of Canada, use of the prostate-specific antigen (PSA) test was less common in Alberta,[18] which may account for this province's relatively small increase in relative survival. Before the advent of PSA, the use of transurethral resection of the prostate (TURP) to treat symptoms of benign prostatic hypertrophy led to an increase in the diagnosis of prostate cancer in Canada and the United States.[19,20] Provincial variations in prostate cancer survival for men diagnosed in the 1985-1987 period may be due to differential use of the TURP procedure during that time. Similarly, differing rates of PSA screening may be the reason for provincial variations in relative survival ratios for prostate cancers diagnosed in the 1992-1994 period.

Use of the PSA test for the diagnosis of prostate cancer became more widespread in Canada around 1990. At the same time, prostate cancer incidence rates began to rise dramatically (Chart 1). It is thought that this increase in new cases could be attributable to the wider use of PSA testing, which increased the likelihood of diagnosis among the large pool of asymptomatic men with latent prostate cancers.[21-23] Increases in prostate cancer relative survival between 1985-1987 and 1992-1994 may also be attributed to PSA screening. Because such screening results in detection of prostate cancer earlier in the disease progression, time from diagnosis to death is extended, leading to increases in relative survival ratios over time.[24-25]

Mortality rates for prostate cancer have decreased somewhat since 1995 (Chart 1). While some of this decline may be explained by earlier diagnosis of patients with aggressive prostate cancer,[26] it is likely that the primary reason behind the decline was improved treatment of later stage disease.[27] Because mortality began to decrease only after 1995, the observed increase in relative survival is probably not due to improvements in treatment, but to lead-time bias created by the diagnosis of large numbers of clinically indolent prostate cancers between 1992 and 1994.

Chart 1
Age-standardized† prostate cancer incidence and mortality rates, Canada, 1985 to 1999



Data sources: National Cancer Incidence Reporting System (1985 to 1991); Canadian Cancer Registry (1992 to 1999); Canadian Vital Statistics Database
† Age-standardized to 1991 Canadian population

Relative survival for breast cancer higher

The age-standardized five-year relative survival ratio for women diagnosed with breast cancer in the 1992-1994 period was 83%, an absolute percentage increase of 7% from the corresponding ratio for 1985-1987 (Table 2). Increases ranged from 5% among women diagnosed between the ages of 40 and 49 to 9% among those diagnosed between the ages of 50 and 59. The primary target of breast screening programs has been women aged 50 to 69. The observed increase in relative survival in this age range is greater than in any other age group, suggesting a screening effect. However, as survival increased for all age groups, improvements in treatment may have also been partly responsible.

Table 2
Five-year relative survival ratios for breast cancer cases diagnosed in 1985-1987 and in 1992-1994, by province† (age-standardized‡) and by age group

	Breast cancer diagnosed in:								
	1985-1987				1992-1994				
	Relative survival ratio	95% confidence interval	Number of cases	Number of deaths§	Relative survival ratio	95% confidence interval	Number of cases	Number of deaths§	Comparison of relative survival ratios
	%				%				p-value
Canada†‡	76	75, 77	23,888	7,664	83*	83, 84	31,802	8,029	0.000
Newfoundland	71	65, 76	439	158	79*	75, 83	645	182	0.013
Prince Edward Island	72	63, 80	140	48	76	68, 83	188	55	0.491
Nova Scotia	70	67, 73	1,105	427	80*	77, 82	1,428	413	0.000
Ontario	75	74, 76	12,781	4,243	83*	82, 84	16,888	4,295	0.000
Manitoba	76	74, 79	1,453	465	81*	79, 84	1,780	504	0.007
Saskatchewan	80	77, 83	1,200	375	84*	82, 87	1,602	400	0.019
Alberta	78	76, 80	2,601	774	83*	82, 85	3,482	836	0.000
British Columbia	80	78, 82	4,152	1,170	86*	84, 87	5,739	1,333	0.000
Age group									
15-99	76	75, 77	23,888	7,664	83	83, 84	31,802	8,029	
15-39	69	67, 71	1,905	599	75*	73, 77	2,058	515	0.000
40-49	78	77, 80	3,872	871	83*	82, 84	5,729	1,005	0.000
50-59	75	74, 76	4,921	1,344	84*	83, 85	6,296	1,155	0.000
60-69	77	76, 79	5,982	1,664	85*	84, 86	7,547	1,578	0.000
70-79	77	75, 79	4,720	1,706	85*	84, 86	6,713	1,913	0.000
80-99	74	70, 77	2,488	1,480	80*	77, 82	3,459	1,863	0.006

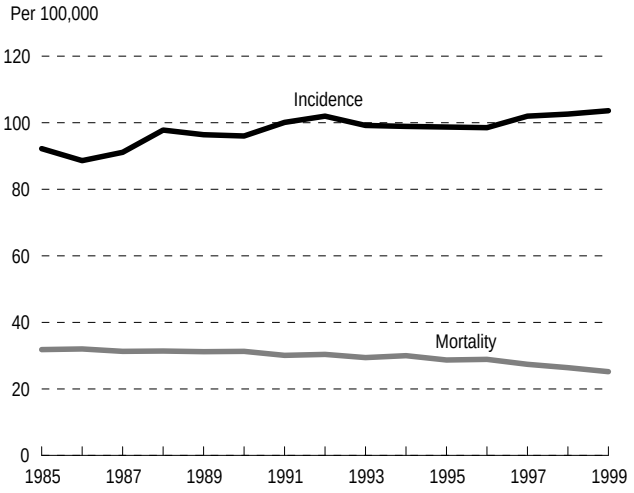
Data sources: National Cancer Incidence Reporting System (1985 to 1987); Canadian Cancer Registry (1992 to 1994); Canadian Vital Statistics Database
† Excluding Québec and New Brunswick. Results for the Yukon and Northwest Territories are not shown because of an insufficient number of cases, but cases from these areas are included in the analysis for Canada.
‡ Age-standardized to 1992 Canadian case distribution for breast cancer (Reference 6)
§ Within first five years of follow-up
** Significantly different from 1985-1987 ratio ($p \leq 0.05$)*

In both periods, five-year relative survival from breast cancer was lowest among women aged 15 to 39, an indication of the more aggressive nature of breast cancer tumours in pre-menopausal women.[28,29]

Increases in relative survival for breast cancer occurred in all provinces between 1985-1987 and 1992-1994, although the increase in Prince Edward Island was not statistically significant. This may have been due to the very small numbers of women diagnosed with breast cancer in that province during that period. Increases in age-standardized provincial survival ratios ranged from 4% in Saskatchewan and Prince Edward Island to 10% in Nova Scotia. Relative survival tended to increase on an east-west gradient in both periods.

Breast cancer incidence rates in Canada rose between 1985 and 1999 (Chart 2). This is likely due

Chart 2
Age-standardized† breast cancer incidence and mortality rates, Canada, 1985 to 1999



Data sources: National Cancer Incidence Reporting System (1985 to 1991); Canadian Cancer Registry (1992 to 1999); Canadian Vital Statistics Database
† Age-standardized to 1991 Canadian population

to a combination of changing reproductive patterns and greater use of mammography screening.[1] At the same time, mortality rates fell, mirroring the increases in relative survival. Earlier diagnosis made possible by mammography screening, as well as advances in treatment, are likely behind these trends.

Increases in survival for colorectal cancer

Statistically significant increases in age-standardized five-year relative survival ratios for colorectal cancer were observed for both sexes. For cases diagnosed in 1985-1987, relative survival was 54% for men and

Table 3
Five-year relative survival ratios for colorectal cancer cases diagnosed in 1985-1987 and in 1992-1994, by province† (age-standardized‡), and by sex and age group

	Colorectal cancer diagnosed in:								
	1985-1987				1992-1994				
	Relative survival ratio	95% confidence interval	Number of cases	Number of deaths§	Relative survival ratio	95% confidence interval	Number of cases	Number of deaths§	Comparison of relative survival ratios
	%				%				p-value
Canada,†‡ men	54	53, 55	13,454	7,737	57*	56, 58	15,526	8,413	0.000
Newfoundland	49	42, 55	356	207	63*	56, 69	462	221	0.004
Prince Edward Island	45	34, 57	118	73	54	42, 65	109	57	0.311
Nova Scotia	54	49, 59	745	430	56	50, 60	720	405	0.747
Ontario	52	51, 54	7,246	4,218	56*	54, 57	8,500	4,635	0.002
Manitoba	51	47, 56	863	521	59*	54, 63	909	484	0.024
Saskatchewan	55	50, 59	738	418	55	51, 60	782	438	0.826
Alberta	53	49, 56	1,217	694	53	50, 56	1,457	830	0.939
British Columbia	58	55, 61	2,167	1,172	58	56, 61	2,563	1,333	0.973
Canada,†‡ women	56	55, 57	12,453	6,703	59*	58, 60	13,335	6,799	0.000
Newfoundland	55	48, 62	341	176	56	50, 62	384	198	0.190
Prince Edward Island	60	48, 70	86	42	60	49, 69	134	65	0.965
Nova Scotia	55	50, 59	686	376	57	52, 61	725	389	0.629
Ontario	55	54, 57	6,932	3,774	59*	58, 60	7,346	3,754	0.000
Manitoba	54	50, 58	814	448	62*	57, 65	793	391	0.007
Saskatchewan	53	49, 58	617	342	60*	55, 64	633	323	0.045
Alberta	56	52, 59	1,099	572	59	55, 62	1,200	614	0.273
British Columbia	58	55, 60	1,876	973	58	56, 61	2,101	1,057	0.698
Age group, men									
15-99	53	52, 54	13,454	7,737	57	56, 58	5,526	8,413	
15-49	54	50, 57	963	456	59*	56, 61	1,205	509	0.020
50-59	54	51, 56	2,218	1,099	59*	57, 61	2,335	1,025	0.001
60-69	54	52, 56	4,247	2,254	58*	56, 60	4,806	2,336	0.001
70-79	55	53, 57	4,164	2,526	57	55, 59	4,853	2,787	0.073
80-99	52	48, 56	1,862	1,402	51	47, 55	2,327	1,756	0.786
Age group, women									
15-99	55	54, 56	12,453	6,703	59	58, 60	13,335	6,799	
15-49	60	56, 63	924	379	63	60, 66	1,083	406	0.115
50-59	58	55, 60	1,633	717	63*	60, 65	1,631	638	0.008
60-69	57	55, 59	3,328	1,574	60*	58, 62	3,154	1,377	0.007
70-79	56	54, 58	3,846	2,071	59*	58, 61	4,223	2,125	0.015
80-99	50	47, 53	2,722	1,962	52	49, 54	3,244	2,253	0.370

Data sources: National Cancer Incidence Reporting System (1985 to 1987); Canadian Cancer Registry (1992 to 1994); Canadian Vital Statistics Database
† Excluding Québec and New Brunswick. Results for the Yukon and Northwest Territories are not shown because of an insufficient number of cases, but cases from these areas are included in the analysis for Canada.
‡ Age-standardized to 1992 Canadian case distribution for colorectal cancer (Reference 6)
§ Within first five years of follow-up
** Significantly different from 1985-1987 ratio ($p \leq 0.05$)*

56% for women (Table 3). By 1992-1994, these ratios had increased to 57% and 59%, respectively. Regardless of time period or sex, relative survival ratios for colorectal cancer tended to be similar for the four age groups between 15 to 49 and 70 to 79, and lowest for those aged 80 to 99 at diagnosis.

Relative survival ratios either increased or remained constant in all provinces across the two periods. Among men, increases were statistically significant in Newfoundland, Ontario and Manitoba. The largest absolute percentage increases were in Newfoundland (14%), Prince Edward Island (9%) and Manitoba (8%), while ratios remained constant in British Columbia, Alberta and Saskatchewan. For women, statistically significant increases occurred in Ontario, Manitoba and Saskatchewan. The largest absolute percentage increases were in Manitoba (8%) and Saskatchewan (7%), while ratios remained constant in British Columbia and Prince Edward Island.

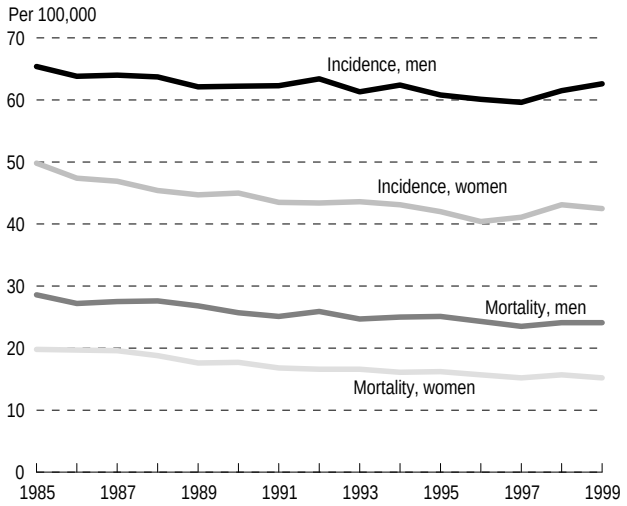
From 1985 to 1997, there was a fairly consistent decline in colorectal cancer incidence and mortality (Chart 3). This likely resulted from changes in exposure to some of the risk factors; for example, use of anti-inflammatory drugs and decreased consumption of dietary fat.[30-32] It is difficult to ascertain whether increases in relative survival reflect changes in diagnosis or treatment.

Lung cancer—little change

There was little absolute change at the national level in five-year relative survival ratios for lung cancer cases diagnosed in 1985-1987 and in 1992-1994. Though small, the slight rise from 13% to 14% for men was statistically significant (Table 4). The lack of statistical significance for the seemingly similar increase among women can be attributed to two factors: the actual increase was smaller (women, 0.6%; men, 1.0%), and because there were approximately half as many cases among women as among men, there was less statistical power to detect a difference. For both sexes, absolute percentage increases in age-specific relative survival ratios between the two periods generally ranged from 1% to 2%. The exceptions were men aged 15 to 49 (+3%) and women aged 70 to 79 (-1%).

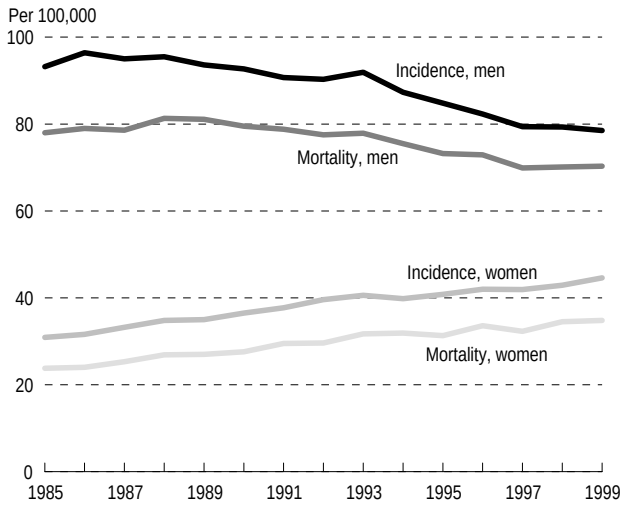
In general, there was little change in provincial five-year relative survival ratios between the two periods. Slight increases among both men and women in Ontario, however, were statistically

Chart 3
Age-standardized† colorectal cancer incidence and mortality rates, by sex, Canada, 1985 to 1999



Data sources: National Cancer Incidence Reporting System (1985 to 1991); Canadian Cancer Registry (1992 to 1999); Canadian Vital Statistics Database
† Age-standardized to 1991 Canadian population

Chart 4
Age-standardized† lung cancer incidence and mortality rates, Canada, by sex, 1985 to 1999



Data sources: National Cancer Incidence Reporting System (1985 to 1991); Canadian Cancer Registry (1992 to 1999); Canadian Vital Statistics Database
† Age-standardized to 1991 Canadian population

Table 4
Five-year relative survival ratios for lung cancer cases diagnosed in 1985-1987 and in 1992-1994, by province[†] (age-standardized[‡]) and by sex and age group

	Lung cancer diagnosed in:								
	1985-1987				1992-1994				
	Relative survival ratio	95% confidence interval	Number of cases	Number of deaths[§]	Relative survival ratio	95% confidence interval	Number of cases	Number of deaths[§]	Comparison of relative survival ratios
	%				%				p-value
Canada,[†‡] men	13	12, 13	17,851	15,932	14*	13, 14	19,759	17,521	0.018
Newfoundland	12	9, 15	465	416	15	11, 18	417	359	0.219
Prince Edward Island	18	11, 26	140	118	8*	5, 11	153	143	0.010
Nova Scotia	14	11, 16	967	854	12	10, 14	1,095	982	0.374
Ontario	12	12, 13	10,042	8,974	14*	14, 15	11,094	9,758	0.000
Manitoba	14	12, 16	1,173	1,036	15	13, 18	1,141	1,001	0.461
Saskatchewan	9	7, 12	889	820	10	8, 12	932	855	0.833
Alberta	11	10, 13	1,513	1,364	11	10, 13	1,906	1,726	0.813
British Columbia	13	12, 15	2,639	2,331	13	12, 14	2,963	2,643	0.503
Canada,[†‡] women	16	15, 17	8,108	6,891	17	16, 17	11,609	9,840	0.241
Newfoundland	15	8, 23	90	76	15	10, 21	132	108	0.974
Prince Edward Island	6	2, 12	35	34	14	8, 21	85	73	0.068
Nova Scotia	12	9, 16	380	335	16	13, 19	560	478	0.198
Ontario	15	14, 17	4,557	3,898	17*	16, 18	6,292	5,306	0.035
Manitoba	20	16, 23	564	460	19	16, 22	672	558	0.642
Saskatchewan	18	14, 22	382	315	16	12, 19	502	429	0.436
Alberta	13	11, 16	707	597	15	13, 18	1,173	997	0.205
British Columbia	16	14, 18	1,373	1,157	15	13, 16	2,153	1,856	0.297
Age group, men									
15-99	13	12, 14	17,851	15,932	14	13, 14	19,759	17,521	
15-49	16	13, 18	941	796	19*	17, 22	1,118	904	0.029
50-59	15	14, 16	3,405	2,922	16	15, 17	2,894	2,452	0.307
60-69	14	13, 15	6,457	5,666	14	13, 15	6,983	6,106	0.889
70-79	11	10, 12	5,359	4,917	13*	12, 14	6,513	5,892	0.048
80-99	7	5, 9	1,689	1,631	7	6, 9	2,251	2,167	0.824
Age group, women									
15-99	17	16, 17	8,108	6,891	17	16, 18	11,609	9,840	
15-49	22	20, 25	799	621	24*	22, 27	1,044	792	0.028
50-59	19	17, 21	1,752	1,428	21*	19, 22	2,005	1,599	0.008
60-69	17	15, 18	2,750	2,319	18*	17, 19	3,738	3,101	0.007
70-79	13	12, 15	2,110	1,872	12	11, 14	3,493	3,118	0.792
80-99	11	8, 14	697	651	12	10, 14	1,329	1,230	0.175

Data sources: National Cancer Incidence Reporting System (1985 to 1987); Canadian Cancer Registry (1992 to 1994); Canadian Vital Statistics Database
† Excluding Québec and New Brunswick. Results for the Yukon and Northwest Territories are not shown because of an insufficient number of cases, but cases from these areas are included in the analysis for Canada.
‡ Age-standardized to 1992 Canadian case distribution for lung cancer (Reference 6)
§ Within first five years of follow-up
** Significantly different from 1985-1987 ratio ($p \leq 0.05$)*

significant. As well, Prince Edward Island had a large increase among women (from 6% to 14%) and a significant decrease for men (from 18% to 8%). The contradictory results in Prince Edward Island may be related to the relatively small number of cases in the province, even over three-year periods, which creates instability in the point estimates.

Since 1985, lung cancer incidence and mortality rates have fallen among men, but have risen among women (Chart 4). These findings are directly attributable to trends in smoking rates, which have been declining among men for several decades, but have only recently begun to drop among women.[1] Changes in exposure to the primary risk factor do

not seem to have affected relative survival ratios for lung cancer between 1985-1987 and 1992-1994.

Concluding remarks

Five-year relative survival ratios for prostate and breast cancer—both among the most commonly diagnosed cancers in Canada—rose substantially between 1985-1987 and 1992-1994. For prostate cancer, five-year relative survival rose from 73% to 89%. The five-year relative survival for breast cancer increased from 76% to 83%. The large numbers of clinically indolent prostate cancers known to exist in the population that were detected through PSA screening have, in particular, contributed to the large survival increase for prostate cancer. Breast cancer survival has likely increased because of a combination of improved treatment and mammography screening.

Relative survival for lung cancer changed little over the period, despite clear advances in the primary prevention of this disease. There were statistically significant increases in five-year relative survival ratios for both men and women with colorectal cancer, but it is difficult to attribute this to any specific factors.

Over the last several decades, there have been major changes in the early detection, diagnosis and treatment of cancer.[1] Studying cancer survival rates over time can provide information on the extent to which these changes have improved the survival experience of cancer patients and may reflect the extent to which these services have become available to the population.[2] ●

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Appendix

Table A
Records remaining after exclusions,† prostate, breast, colorectal and lung cancer cases diagnosed in 1985-1987, by province

Restricted to ...	Canada‡	Nfld	PEI	NS	Ont	Man	Sask	Alta	BC
Prostate									
First tumour only	18,074	308	115	843	8,468	1,258	1,221	1,970	3,885
Year of birth and/or death available	18,064	308	115	843	8,458	1,258	1,221	1,970	3,885
Age at diagnosis ≥ 15 and ≤ 99	18,046	308	115	843	8,451	1,258	1,220	1,968	3,877
Cancer not diagnosed by autopsy or by DCO§	17,589	297	113	805	8,368	1,227	1,177	1,912	3,687
Breast									
First tumour only	24,189	446	144	1,144	12,886	1,471	1,215	2,635	4,231
Year of birth and/or death available	24,177	446	144	1,144	12,875	1,471	1,215	2,634	4,231
Age at diagnosis ≥ 15 and ≤ 99	24,155	446	144	1,142	12,866	1,470	1,214	2,628	4,228
Cancer not diagnosed by autopsy or by DCO§	23,890	439	140	1,105	12,781	1,453	1,202	2,601	4,152
Colorectal									
First tumour only	26,729	710	212	1,534	14,422	1,713	1,417	2,390	4,321
Year of birth and/or death available	26,703	710	212	1,533	14,397	1,713	1,417	2,390	4,321
Age at diagnosis ≥ 15 and ≤ 99	26,678	710	211	1,531	14,386	1,710	1,416	2,388	4,316
Cancer not diagnosed by autopsy or by DCO§	25,907	697	204	1,431	14,178	1,677	1,355	2,316	4,043
Lung									
First tumour only	27,877	576	196	1,554	15,122	1,798	1,412	2,469	4,694
Year of birth and/or death available	27,863	576	196	1,554	15,109	1,798	1,412	2,469	4,693
Age at diagnosis ≥ 15 and ≤ 99	27,856	576	196	1,554	15,107	1,798	1,411	2,468	4,690
Cancer not diagnosed by autopsy or by DCO§	25,963	555	175	1,347	14,599	1,738	1,271	2,221	4,012

Data source: National Cancer Incidence Reporting System
Note: Yukon and Northwest Territories not displayed because of small numbers
† Four lung cancer (2 NWT, 1 Alta, 1 Man), two breast cancer (2 Sask), and one prostate cancer case (Nfld) were also excluded owing to negative survival values.
‡ Excluding Québec and New Brunswick
§ Death certificate only

Table B
Records remaining after exclusions,† prostate, breast, colorectal and lung cancer cases diagnosed in 1992-1994, by province

Restricted to ...	Canada‡	Nfld	PEI	NS	Ont	Man	Sask	Alta	BC
Prostate									
First tumour only	35,324	524	307	1,637	17,028	2,593	2,102	3,605	7,498
Year of birth and/or death available	35,295	517	307	1,637	17,006	2,593	2,102	3,605	7,498
Age at diagnosis ≥ 15 and ≤ 99	35,279	517	307	1,636	16,997	2,593	2,101	3,602	7,496
Cancer not diagnosed by autopsy or by DCO§	34,933	517	304	1,580	16,898	2,569	2,065	3,592	7,379
Breast									
First tumour only	32,077	647	189	1,467	17,039	1,794	1,611	3,483	5,797
Year of birth and/or death available	32,065	645	189	1,465	17,031	1,794	1,611	3,483	5,797
Age at diagnosis ≥ 15 and ≤ 99	32,053	645	189	1,464	17,024	1,793	1,611	3,482	5,795
Cancer not diagnosed by autopsy or by DCO§	31,802	645	188	1,428	16,888	1,780	1,602	3,482	5,739
Colorectal									
First tumour only	29,432	860	248	1,525	16,057	1,741	1,453	2,672	4,833
Year of birth and/or death available	29,414	852	248	1,523	16,049	1,741	1,453	2,672	4,833
Age at diagnosis ≥ 15 and ≤ 99	29,392	850	247	1,516	16,041	1,741	1,452	2,671	4,831
Cancer not diagnosed by autopsy or by DCO§	28,861	846	243	1,445	15,846	1,702	1,415	2,657	4,664
Lung									
First tumour only	32,909	567	249	1,881	17,902	1,894	1,556	3,113	5,648
Year of birth and/or death available	32,892	557	249	1,880	17,897	1,894	1,555	3,113	5,648
Age at diagnosis ≥ 15 and ≤ 99	32,876	556	249	1,879	17,889	1,894	1,555	3,111	5,644
Cancer not diagnosed by autopsy or by DCO§	31,368	549	238	1,655	17,386	1,813	1,434	3,079	5,116

Data source: Canadian Cancer Registry
Note: Yukon and Northwest Territories not displayed because of small numbers
† There were no exclusions resulting from date of diagnosis after date of death.
‡ Excluding Québec and New Brunswick
§ Death certificate only

Table C
Percentage of death certificate only (DCO) cases,† prostate, breast, colorectal and lung cancer diagnosed in 1985-1987, by province

Restricted to ...	Canada‡	Nfld	PEI	NS	Ont	Man	Sask	Alta	BC
Prostate cancer									
Eligible cases + DCOs	17,885	300	115	841	8,412	1,243	1,191	1,956	3,821
DCOs	296	3	2	36	44	16	14	44	134
% of otherwise eligible cases	1.7	1.0	1.7	4.3	0.5	1.3	1.2	2.2	3.5
Breast cancer									
Eligible cases + DCOs	24,136	444	144	1,142	12,862	1,467	1,210	2,627	4,223
DCOs	246	5	4	37	81	14	8	26	71
% of otherwise eligible cases	1.0	1.1	2.8	3.2	0.6	1.0	0.7	1.0	1.7
Colorectal cancer									
Eligible cases + DCOs	26,518	705	209	1,525	14,354	1,699	1,387	2,375	4,254
DCOs	611	8	5	94	176	22	32	59	211
% of otherwise eligible cases	2.3	1.1	2.4	6.2	1.2	1.3	2.3	2.5	5.0
Lung cancer									
Eligible cases + DCOs	27,388	558	193	1,540	14,999	1,764	1,341	2,426	4,514
DCOs	1,425	3	18	193	400	26	70	205	502
% of otherwise eligible cases	5.2	0.5	9.3	12.5	2.7	1.5	5.2	8.5	11.1

Data source: National Cancer Incidence Reporting System
Note: Yukon and Northwest Territories not displayed because of small numbers
*† Calculated as DCO cases * 100 / (eligible cases + DCOs)*
‡ Excluding Québec and New Brunswick

Table D
Percentage of death certificate only (DCO) cases,† prostate, breast, colorectal and lung cancer diagnosed in 1992-1994, by province

Restricted to ...	Canada‡	Nfld§	PEI	NS	Ont	Man	Sask	Alta	BC
Prostate cancer									
Eligible cases + DCOs	35,208	517	305	1,632	16,988	2,591	2,079	3,594	7,472
DCOs	275	...	1	52	90	22	14	2	93
% of otherwise eligible cases	0.8	...	0.3	3.2	0.5	0.8	0.7	0.1	1.2
Breast cancer									
Eligible cases + DCOs	32,045	645	189	1,463	17,026	1,793	1,606	3,482	5,791
DCOs	243	...	1	35	138	13	4	0	52
% of otherwise eligible cases	0.8	...	0.5	2.4	0.8	0.7	0.2	0.0	0.9
Colorectal cancer									
Eligible cases + DCOs	29,302	846	245	1,505	16,025	1,738	1,439	2,660	4,801
DCOs	441	...	2	60	179	36	24	3	137
% of otherwise eligible cases	1.5	...	0.8	4.0	1.1	2.1	1.7	0.1	2.9
Lung cancer									
Eligible cases + DCOs	32,597	549	240	1,855	17,853	1,878	1,514	3,083	5,526
DCOs	1,229	...	2	200	467	65	80	4	410
% of otherwise eligible cases	3.8	...	0.8	10.8	2.6	3.5	5.3	0.1	7.4

Data source: Canadian Cancer Registry
Note: Yukon and Northwest Territories not displayed because of small numbers
*†Calculated as DCO cases * 100 / (eligible cases + DCOs)*
‡ Excluding Québec and New Brunswick
§ Could not have DCO cases, because province did not use information from vital statistics registry to update data.
··· Not applicable

Table E
Non-standardized five-year relative survival ratios for prostate, breast, colorectal and lung cancer cases diagnosed in 1985-1987 and in 1992-1994, ages 15 to 99, by sex and province

	Cancer diagnosed in:							
	1985-1987				1992-1994			
	Relative survival ratios	95% confidence interval	Number of cases	Number of deaths	Relative survival ratios	95% confidence interval	Number of cases	Number of deaths
	%				%			
				Prostate				
Newfoundland	62	54, 70	296	166	86	80, 91	517	196
Prince Edward Island	63	48, 74	113	66	89	80, 94	304	105
Nova Scotia	71	66, 75	805	407	90	87, 93	1,580	543
Ontario	72	71, 74	8,368	4,135	90	89, 91	16,898	5,413
Manitoba	72	68, 75	1,227	620	93	91, 95	2,569	788
Saskatchewan	69	65, 72	1,177	604	88	85, 90	2,065	689
Alberta	76	73, 79	1,912	864	86	84, 88	3,592	1,255
British Columbia	80	78, 82	3,687	1,507	94	93, 95	7,379	1,998
				Breast				
Newfoundland	72	67, 76	439	158	79	75, 82	645	182
Prince Edward Island	77	67, 84	140	48	79	71, 85	188	55
Nova Scotia	70	66, 73	1,105	427	81	78, 83	1,428	413
Ontario	75	74, 76	12,781	4,243	83	82, 83	16,888	4,295
Manitoba	76	74, 79	1,453	465	82	79, 84	1,780	504
Saskatchewan	77	75, 80	1,200	375	85	82, 87	1,602	400
Alberta	77	75, 78	2,601	774	83	81, 84	3,482	836
British Columbia	80	78, 81	4,152	1,170	85	84, 86	5,739	1,333
				Colorectal, men				
Newfoundland	51	45, 57	356	207	64	59, 69	462	221
Prince Edward Island	48	37, 59	118	73	58	46, 69	109	57
Nova Scotia	54	49, 58	745	430	56	52, 60	720	405
Ontario	52	51, 54	7,246	4,218	56	55, 58	8,500	4,635
Manitoba	50	46, 54	863	521	59	55, 63	909	484
Saskatchewan	55	51, 59	738	418	56	52, 60	782	438
Alberta	53	50, 56	1,217	694	54	50, 57	1,457	830
British Columbia	57	55, 60	2,167	1,172	59	57, 61	2,563	1,333
				Colorectal, women				
Newfoundland	56	50, 62	341	176	57	51, 63	384	198
Prince Edward Island	64	49, 76	86	42	62	51, 70	134	65
Nova Scotia	54	50, 59	686	376	57	53, 62	725	389
Ontario	55	54, 56	6,932	3,774	58	57, 59	7,346	3,754
Manitoba	53	49, 57	814	448	61	57, 65	793	391
Saskatchewan	53	48, 58	617	342	59	54, 63	633	323
Alberta	56	53, 59	1,099	572	59	55, 62	1,200	614
British Columbia	57	54, 60	1,876	973	59	57, 62	2,101	1,057
				Lung, men				
Newfoundland	13	9, 16	465	416	17	13, 21	417	359
Prince Edward Island	18	12, 25	140	118	8	4, 13	153	143
Nova Scotia	14	12, 17	967	854	13	11, 15	1,095	982
Ontario	13	12, 14	10,042	8,974	14	14, 15	11,094	9,758
Manitoba	14	12, 17	1,173	1,036	15	13, 18	1,141	1,001
Saskatchewan	9	7, 12	889	820	10	8, 12	932	855
Alberta	12	10, 14	1,513	1,364	11	10, 13	1,906	1,726
British Columbia	14	13, 15	2,639	2,331	13	12, 14	2,963	2,643
				Lung, women				
Newfoundland	16	9, 25	90	76	19	13, 26	132	108
Prince Edward Island	3	0, 14	35	34	15	8, 24	85	73
Nova Scotia	13	10, 17	380	335	16	13, 20	560	478
Ontario	16	15, 17	4,557	3,898	17	16, 18	6,292	5,306
Manitoba	21	17, 25	564	460	19	16, 22	672	558
Saskatchewan	19	15, 23	382	315	16	13, 20	502	429
Alberta	17	14, 20	707	597	17	14, 19	1,173	997
British Columbia	17	15, 19	1,373	1,157	15	14, 17	2,153	1,856

Data sources: National Cancer Incidence Reporting System (1985 to 1987); Canadian Cancer Registry (1992 to 1994)

Influenza vaccination

Helen Johansen, Kathy Nguyen, Luling Mao, Richard Marcoux, Ru-Nie Gao and Cyril Nair

Abstract

Objectives

This article compares influenza vaccination rates in 1996/97 and 2000/01 and describes the characteristics of adults who were vaccinated.

Data sources

The data on influenza vaccination are from the 1996/97 National Population Health Survey and the 2000/01 Canadian Community Health Survey, both conducted by Statistics Canada. Data on hospitalizations and deaths are from the Hospital Mortality Data Base and the Canadian Mortality Data Base, respectively.

Analytical techniques

Cross-tabulations were used to estimate rates of vaccination among seniors, people with chronic conditions, and the total population aged 20 or older. Multiple logistic regression was used to assess relationships between being vaccinated and selected characteristics.

Main results

Between 1996/97 and 2000/01, the percentage of Canadians aged 20 or older who reported having had a flu shot the previous year rose from 16% to 28%. Rates were higher for seniors and people with chronic conditions. The odds of vaccination were high for residents of middle-to-high income households, people with at least some postsecondary education, former smokers, and people with a regular doctor. Smokers and people who reported their health as good to excellent had lower odds of being vaccinated.

Key words

immunization, preventive health services, community health services, population-based health planning

Authors

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Influenza or "the flu" is a viral infection that affects an estimated 10% to 25% of Canadians each year, usually between November and May.[1] The symptoms include a cough, fever, chills and muscle aches. While most people recover within a week or two, some may suffer serious complications, such as pneumonia or heart failure, that require hospitalization and that could even lead to death (see *Influenza immunization, hospitalizations and deaths*). The severity of the flu varies from year to year, as new viruses emerge.

A decade ago in Canada, a national consensus conference recommended that seniors and people of any age with medical conditions that place them at high risk for influenza-related complications receive an annual flu shot;[2] the target immunization rate was set at 70%. While the recent *Canadian Immunization Guide* suggests that priority be given to ensuring vaccination of these "high-risk groups," it also states, "Healthy adults and their children who wish to protect themselves from influenza should be encouraged to receive the vaccine."[3] This recommendation is supported by the results of recent studies showing that immunization of healthy adults and children may be cost-effective under some circumstances.[4-10] However, although some experts support

universal immunization,[11] others are critical, citing varying estimates of the efficacy of vaccination.[12]

This article, based on data from the 1996/97 National Population Health Survey (NPHS) and the 2000/01 Canadian Community Health Survey (CCHS), discusses the extent of influenza vaccination among seniors, adults with certain chronic conditions, and the total population aged 20 or older (see *Definitions, Methods* and *Limitations*). Reasons for not being immunized are presented for seniors.

Influenza immunization, hospitalizations and deaths

Influenza vaccines are not a recent innovation; they have, in fact, been available since the 1940s,[13,14] but their use has only recently become widespread. During the 2000/01 flu season, approximately 10 million doses of flu vaccine were distributed in Canada.[15]

The vaccine, made from fragments of inactivated influenza viruses, offers protection by building immunity or antibodies, so that when a "live" virus does show up, the body's defences are ready.[16] There are three types of influenza viruses: Types A, B and C. Types A and B cause epidemics almost every winter; Type C causes a mild respiratory illness and is not thought to cause epidemics. A flu shot can prevent illness from types A and B, but does not protect against Type C.[17]

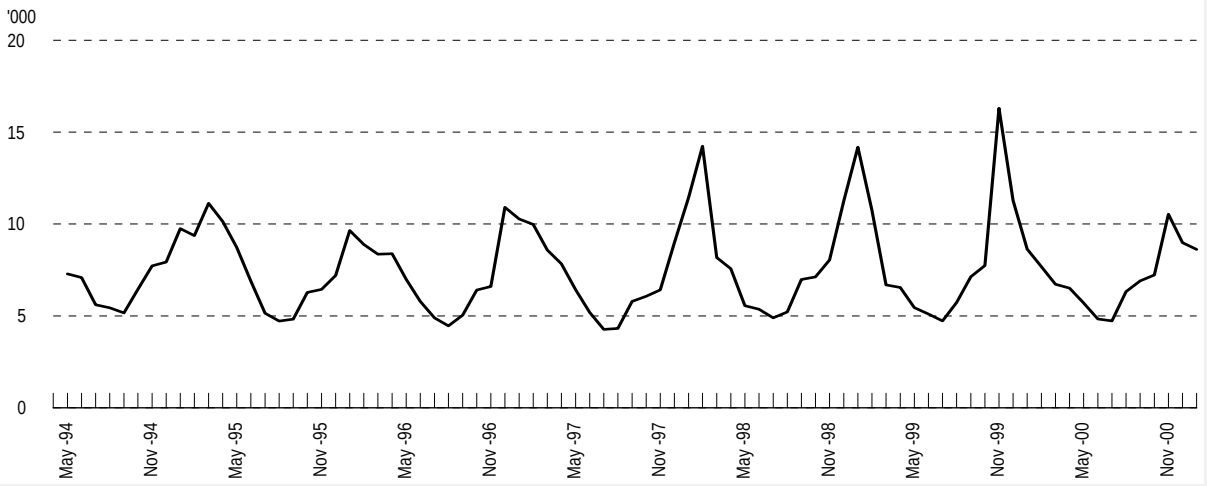
The viruses that cause influenza mutate rapidly,[17] so vaccines are updated annually to include viruses similar to the strains circulating throughout the world at the time. Because the viruses change so often, people at high risk are advised to receive a shot every year,[13,14] ideally between mid-October and mid-November.[18] The vaccine becomes effective about two weeks after the injection and lasts about six months.

No vaccine gives complete protection. If the influenza strains have been accurately predicted, the vaccine is 70% to 90% effective for healthy people younger than 65, but less so for seniors.[16] Even so, people who develop the flu after being vaccinated generally experience milder symptoms than they would have without the shot, and complications are less likely.

Each year a substantial number of people are hospitalized for influenza and influenza-related complications (notably, pneumonia). These hospitalizations follow a yearly cycle, peaking in the winter months and bottoming out during the summer. The number varies, depending on the severity of the flu strain that year (chart).

Similarly, the annual number of deaths caused by flu varies, again reflecting the strain. From 1990 to 2000, the figure ranged from just 122 (in 1992) to 762 (in 1998).[19]

Hospital stays with diagnosis of influenza/pneumonia,† by month, Canada, April 1994 to December 2000



Data source: Statistics Canada, Hospital Morbidity Database, 1994/95 to 2000/01
† International Classification of Diseases (ICD-9) codes 481 to 487 (Reference 20)

Definitions

Respondents to the 1996/97 National Population Health Survey (NPHS) and the 2000/01 Canadian Community Health Survey (CCHS) were asked: "Have you ever had a flu shot?" Those who had were asked when they had had their last shot: less than one year ago; one year to less than two years ago; and two years ago or more. Respondents aged 65 or older who indicated that they had not been vaccinated within the past year were asked why not. Proxy responses were not accepted for either of these questions.

The presence of a *chronic condition* was determined by asking respondents if they had any "long-term conditions that had lasted or were expected to last six months or more and that had been diagnosed by a health professional." A list of conditions was read to respondents. Those who reported asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, or effects of a stroke were considered to have a condition for which influenza vaccination was recommended (see *Limitations*).

Two *age groups* were considered: 20 to 64, and 65 or older.

Household income was based on the number of people in the household and total household income from all sources in the 12 months before the 2000/01 CCHS interview. For this analysis, two income groups were defined:

Household income group	People in household	Total household income
Lower	1 or 2	Less than $29,999
	3 or 4	Less than $39,999
	5 or more	Less than $59,999
Higher	1 or 2	$30,000 or more
	3 or 4	$40,000 or more
	5 or more	$60,000 or more

Three *education* categories were considered: less than secondary graduation, secondary graduation, and at least some postsecondary.

Smoking status was defined as never, former, or daily/occasional.

Respondents were asked if they had a *regular medical doctor*.

Two categories of *self-reported health* were considered: poor/fair and good/very good/excellent.

In accordance with the *International Classification of Diseases, Ninth Revision* (ICD-9)[20] codes, a hospitalization for influenza/pneumonia was defined as the presence of any code in the 481 to 487 range among the top three diagnostic codes on the patient's record. For the mortality data, influenza was identified by code 487.

Sharp rise

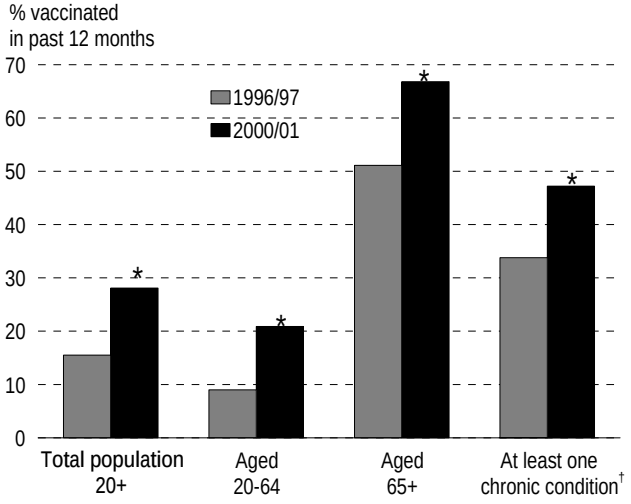
In 2000/01, 28% of Canadians aged 20 or older reported that they had been vaccinated against influenza sometime in the previous year. This was up substantially from 1996/97, when fewer than 16% reported having had a flu shot. Rates, however, differed substantially, depending on whether respondents were members of groups that had been targeted for coverage (Chart 1).

Seniors were most likely to have been vaccinated. In 2000/01, two-thirds of people aged 65 or older reported that they had had a flu shot the previous year, up from just over half in 1996/97.

The vaccination rate was also relatively high for adults (aged 20 or older) with at least one chronic condition that made them especially vulnerable to complications of flu—asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer and effects of stroke. In 2000/01, 47% of people with at least one of these conditions had had a flu shot, a significant increase from 34% in 1996/97.

There was, however, considerable provincial variation in flu shot rates: overall and for these two

Chart 1
Influenza vaccination rates, by age and presence of chronic conditions, household population aged 20 or older, Canada excluding territories, 1996/97 and 2000/01



Data sources: 1996/97 National Population Health Survey, cross-sectional sample, Health file; 2000/01 Canadian Community Health Survey, fourth quarter
Note: Groups for whom vaccination rates are calculated are not mutually exclusive.
† Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke
** Significantly higher than 1996/97 ($p \leq 0.05$)*

target groups. To some extent, this may be related to efforts that different provinces have made to reach susceptible populations and to promote the benefits of being immunized.

Widely available

Most provinces have offered publicly funded influenza immunization to seniors and people with chronic conditions since at least the mid-1990s (Table 1). In 2000, all provinces except Prince Edward Island and New Brunswick provided vaccine to seniors (New Brunswick extended coverage to seniors in 2003), and only Prince Edward Island did not cover people with chronic conditions. Ontario, however, was the only province that provided flu shots to all residents. Perhaps for this reason, 37% of Ontario adults reported in 2000/01 that they had been immunized the previous year, the highest rate in the country (Table 2).

Ontario also had the highest immunization rate for seniors. In 2000/01, close to three-quarters of Ontario's population aged 65 or older reported that they had had a flu shot. By contrast, the percentages of seniors who had been immunized were significantly below the national figure in Newfoundland, New Brunswick and Québec.

As well, Ontario was the only province where the vaccination rate (58%) for people with chronic conditions (asthma, bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke) significantly exceeded the percentage for Canada. On the other hand, rates for people with these conditions were significantly below the national level in Newfoundland, Québec, Saskatchewan and Alberta.

Provincial rates rising

In every province except Newfoundland, flu vaccination rates rose between 1996/97 and 2000/01. The largest increase was in Ontario, possibly owing to the provincial initiative that made flu vaccine available at no charge to every resident.

The reasons for the increases in overall vaccination rates in other provinces are less obvious. In Québec, the *projets spéciaux* were started in 1999 to promote and improve accessibility to influenza vaccination,[21,22] and in 2000, the age threshold for funding coverage was lowered from 65 to 60. During the same period, some provinces began providing flu shots to groups besides seniors and people with chronic conditions. For instance, Alberta's program was expanded to include employees in health care facilities and in other settings that provide health services to people at risk; in 2000/01, British Columbia began providing the vaccine to emergency responders (police, fire, ambulance personnel) and independent health care practitioners and their staff.

Table 1
Publicly funded vaccination programs and increase in vaccination rates, by province, 1996 and 2000

	Age 65 or older			At least one chronic condition†			All adults		
	Covered by program		Increase in vaccination rate, 1996/97 to 2000/01	Covered by program		Increase in vaccination rate, 1996/97 to 2000/01	Covered by program		Increase in vaccination rate, 1996/97 to 2000/01
	1996	2000		1996	2000		1996	2000	
Newfoundland	yes	yes		yes	yes		no	no	
Prince Edward Island	no	no		no	no		no	no	*
Nova Scotia	yes	yes	*	yes	yes		no	no	*
New Brunswick	no	no‡	*	yes	yes		no	no	*
Québec	yes	yes§	*	yes	yes	*	no	no	*
Ontario	yes	yes	*	yes	yes	*	no	yes	*
Manitoba	yes	yes	*	yes	yes	*	no	no	*
Saskatchewan	yes	yes	*	yes	yes	*	no	no	*
Alberta	yes	yes	*	yes	yes		no	no	*
British Columbia	yes	yes	*	yes	yes	*	no	no	*

† Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke
‡ In 2003, the program was expanded to include the population aged 65 or older.
§ Program covered those aged 60 or older since 2000.
** Rate in 2000 significantly higher than rate in 1996 ($p < 0.05$)*

Table 2
Influenza vaccination rates, by age, presence of chronic conditions and province, household population aged 20 or older, Canada excluding territories, 1996/97 and 2000/01

	Age 65 or older		At least one chronic condition†		Total population aged 20 or older	
	1996/97	2000/01	1996/97	2000/01	1996/97	2000/01
	%		%		%	
Canada	51.1	66.8‡	33.8	47.2‡	15.5	28.1‡
Newfoundland	47.5	48.9*	35.2	28.9*	12.8*	12.1*
Prince Edward Island	55.9	65.2	38.1	47.2	18.1	22.2‡*
Nova Scotia	60.1*	71.0‡	43.6*	48.1	20.2*	25.0‡*
New Brunswick	48.3	61.5‡*	34.8	42.8	16.6	20.5‡*
Québec	33.9*	59.2‡*	18.7*	35.6‡*	8.7*	20.0‡*
Ontario	59.5*	72.5‡*	39.1*	58.2‡*	18.4*	37.0‡*
Manitoba	51.9	62.2‡	35.6	45.7‡	15.9	23.4‡*
Saskatchewan	53.3	63.5‡	30.2	39.7‡*	14.8	20.7‡*
Alberta	59.2*	68.7‡	36.7*	38.5*	16.7*	24.0‡*
British Columbia	52.5	68.1‡	39.7*	47.3‡	18.5*	27.5‡

Data sources: 1996/97 National Population Health Survey, cross-sectional sample, Health file; 2000/01 Canadian Community Health Survey, fourth quarter
Note: Groups for whom vaccination rates are calculated are not mutually exclusive.
† Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke
‡ Significantly different from 1996/97 (p < 0.05)
** Significantly different from national rate (p < 0.05)*

Nonetheless, the focus of all provincial programs remains the two target groups: seniors and people with chronic conditions. For seniors, increases in immunization rates between 1996/97 and 2000/01 were significant in eight provinces: Nova Scotia, New Brunswick, Québec, Ontario, Manitoba, Saskatchewan, Alberta and British Columbia. The largest increase was in Québec, where the rate among elderly people rose by 75%, consistent with the results of Québec surveys.[21,23] Increases in the immunization rates of people with chronic conditions were statistically significant in Québec, Ontario, Manitoba, Saskatchewan and British Columbia. Again, the largest percentage change was in Québec, where the rate almost doubled.

Likelihood varies

The sharp differences in immunization rates between seniors, people with chronic conditions and the adult population overall indicate that everyone is not equally likely to have a flu shot. Moreover, being a member of one of the groups recommended for vaccination was not the only factor involved.

In 2000/01, 32% of women, compared with 24% of men, reported that they had been immunized (Table 3). Former smokers were more likely than people who had never smoked to have been vaccinated (33% versus 29%), while daily or occasional smokers were considerably less likely (20%). Having a regular doctor also seemed to make a difference, as 31% of such people had had a flu shot, compared with just 10% who did not have a regular doctor. In addition, an individual's opinion of his or her health was important: 46% who considered themselves to be in fair or poor health had been vaccinated against flu, compared with 26% who assessed their health as good, very good or excellent.

Of course, these factors do not exist in isolation. For instance, seniors with a chronic condition may not consider themselves to be in good health, and they might be more likely than someone in better health to have a regular doctor. However, when such potentially confounding effects were taken into consideration, most of these relationships persisted.

Compared with women, men had significantly low odds of having had a flu shot. Odds were also low for people who considered themselves in good to excellent health, and for those who smoked. Having a regular doctor increased the odds of being immunized, as did being a former smoker. In addition, people in middle- to high-income households had elevated odds of vaccination. And

Methods

Data sources

Most of the analysis in this article is based on data from the 1996/97 National Population Health Survey and the 2000/01 Canadian Community Health Survey, both conducted by Statistics Canada.

National Population Health Survey

The biennial National Population Health Survey (NPHS), which began in 1994/95, covers household and institutional residents in all provinces and territories, except residents of Indian reserves, Canadian Forces bases, and some remote areas. The NPHS has both cross-sectional and longitudinal components.

Individual data are organized into the General file and the Health file. The General file contains socio-demographic and some health information for each member of participating households. Additional, in-depth health information collected for one randomly selected household member, as well as the information in the General file pertaining to that individual, is in the Health file. This analysis uses cross-sectional data from the 1996/97 NPHS (cycle 2) and pertains to the household population in the 10 provinces.

Data on flu shots come from the Health file. The 1996/97 cross-sectional response rate for the Health file was 79.0%. The sample for this analysis consisted of 66,435 respondents who were aged 20 or older in 1996/97 (weighted to represent approximately 21.3 million individuals), and who replied to questions about flu shots. More detailed descriptions of the NPHS design, sample and interview procedures can be found in published reports.[24,25]

Canadian Community Health Survey

The Canadian Community Health Survey (CCHS) collects cross-sectional information every two years. Data collection for the first cycle began in September 2000 and continued over 14 months. The survey covers the household population aged 12 or older in the provinces and territories, except residents of Indian reserves, Canadian Forces bases, and some remote areas. The responding sample for the first cycle was 131,535, yielding a response rate of 84.7%. More detailed descriptions of the CCHS design, sample and interview procedures are available in a published report.[26]

This analysis uses data for the 10 provinces from the fourth quarter of the first cycle (June to August 2001), in which respondents were asked about influenza vaccination. The sample consists of 30,735 respondents who were aged 20 or older (weighted to represent approximately 22.6 million individuals) and who replied to questions about flu shots.

Supplementary data

The data on influenza hospitalizations are from the Hospital Morbidity Data Base, maintained by Statistics Canada until 1994/95, and by the Canadian Institute for Health Information since 1995/96. The information in this database comes from the admission/separation form completed by general and allied special care hospitals at the end of each stay when a patient is "separated" as a discharge or death. The file contains data on all inpatient cases separated during the fiscal year. Because a patient may be admitted and discharged several times during one year, the statistics are a count of separations, not individual patients.

Mortality data are from the Canadian Vital Statistics Data Base, maintained by Statistics Canada, which compiles information provided by the vital statistics registrars in each province and territory.

Analytical techniques

Cross-tabulations based on data from the 1996/97 NPHS and 2000/01 CCHS were used to estimate national and provincial proportions of people who received an influenza vaccination in the previous year, overall for the population aged 20 or older, and for seniors and for individuals with chronic conditions. Multiple logistic regression was used to examine reports of immunization in 2000/01 in relation to selected characteristics: age, sex, presence of chronic conditions, household income, education, smoking status, having a regular doctor, and self-reported health. Cross-tabulations of 2000/01 CCHS data were used to determine reasons why seniors were not vaccinated.

The data were weighted to represent the demographic makeup of the Canadian population in 1996/97 and 2000/01. To account for survey design effects, standard errors and coefficients of variation were estimated with the bootstrap technique.[27-29] The significance level was set at $p < 0.05$.

Table 3
Rates of and adjusted odds ratios for influenza vaccination, by selected characteristics, household population aged 20 or older, Canada excluding territories, 2000/01

	Rate	Adjusted odds ratio	95% confidence interval
	%		
Total	28.1	...	...
Sex			
Men	24.4*	0.78*	0.73, 0.83
Women†	31.6	1.00	...
Age group			
20-64†	20.9	1.00	...
65+	66.8*	6.05*	5.63, 6.49
At least one chronic condition‡			
Yes	47.2*	1.98*	1.83, 2.14
No†	23.6	1.00	...
Household income			
Lower†	27.2	1.00	...
Higher	28.1	1.47*	1.31, 1.64
Education			
Less than high school graduation†	35.9	1.00	...
High school graduation	25.3*	1.00	0.91, 1.10
At least some postsecondary	26.2*	1.13*	1.03, 1.24
Smoking status			
Never†	29.2	1.00	...
Former	32.6*	1.12*	1.04, 1.21
Daily/Occasional	20.1*	0.79*	0.72, 0.86
Has regular doctor			
Yes	31.4*	2.90*	2.56, 3.28
No†	10.7	1.00	...
Self-reported health			
Poor/Fair†	45.8	1.00	...
Good/Very good/Excellent	25.7*	0.66*	0.59, 0.73

Data source: 2000/01 Canadian Community Health Survey, fourth quarter
† Reference category
‡ Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke
** Significantly different from reference group (p < 0.05)*
... Not applicable

although a relatively large proportion of people with less than high school graduation had been immunized, when the effects of the other variables were controlled, the odds of having had a flu shot were actually higher for those who had at least some postsecondary education. This paradoxical finding probably reflects the adjustment for age.

Why not?

Experts have identified several factors that may contribute to underutilization of influenza vaccination among high-risk groups: scepticism about the vaccine's effectiveness and uncertainty about side effects; cavalier attitudes toward health; lack of physician contact; low physician reimbursement for vaccination; perception of influenza as a minor illness; and inconvenience.[30-33]

Results from the 2000/01 CCHS confirm that some of these factors are deterrents, at least among

Limitations

Data from the National Population Health Survey (NPHS) and the Canadian Community Health Survey (CCHS) are subject to the problems inherent in self-reported information. No independent source was available to verify if people who reported that they had received a flu shot had actually had one, although a Québec study showed self-reports of influenza vaccination to be valid when they were compared with medical chart data.[29] As well, it is not known if people who reported having received a professional diagnosis of a chronic condition actually did have the condition.

The current *Canadian Immunization Guide* recommends annual vaccination of the elderly and people with medical conditions that place them at high risk of influenza-related complications.[3] These conditions are chronic cardiac and pulmonary disorders (including bronchopulmonary dysplasia, cystic fibrosis and asthma), diabetes mellitus, cancer, immunodeficiency, immunosuppression, renal disease, anemia and hemoglobinopathy. Because the NPHS and CCHS did not collect information on all of these conditions, the group identified in this article as having a chronic condition that heightened their susceptibility to complications of influenza (asthma, heart disease, effects of a stroke, chronic bronchitis/emphysema, diabetes, or cancer) is a subset of the actual target population.

The NPHS and CCHS data used in this analysis pertain to the household population. This may bias the results, especially for seniors, because it excludes residents of long-term health care facilities, whose characteristics and experiences may differ from those of household residents. And even for the household population, those who participated in the surveys may have been healthier and more likely than non-respondents to engage in health-promoting behaviour.

The CCHS results apply only to the fourth quarter of data collection, so the sample size (30,735) is less than half that of the 1996/97 NPHS (about 66,435), and the variance on the results is greater. As well, the fourth quarter of the CCHS occurred during the summer, which may have affected perceptions of health, compared with responses that might have been obtained in the winter.

Table 4
Seniors' reasons for not having influenza vaccination, unvaccinated household population aged 65 or older, Canada excluding territories, 1996/97 and 2000/01

	1996/97	2000/01
Total not vaccinated ('000)	1,567	1,146
Reason (%)		
Unnecessary	71	63*
Did not get around to it	12	13
Previous bad reaction	9	9
Doctor said unnecessary	6	5
Fear	3	3[E1]
Not available	2[E2]	F
Other	2[E1]	7*

Data sources: 1996/97 National Population Health Survey, cross-sectional sample, Health file; 2000/01 Canadian Community Health Survey, fourth quarter
Note: Because more than one answer was accepted, total sums to more than 100%.
E1 Coefficient of variation 16.6% to 25.0%
E2 Coefficient of variation 25.0% to 33.3%
F Coefficient of variation greater than 33.3%
** Significantly different from 1996/97 ($p < 0.05$)*

the elderly. Although a two-thirds majority of seniors reported having had a flu shot in 2000/01, this left a substantial number who had not. The primary reason for not being vaccinated—mentioned by 63% who had not had a flu shot—was that they did not think it was necessary (Table 4). This was down from 1996/97, when 71% who had not been vaccinated felt that it was unnecessary. In both periods, the second-ranking reason was not getting around to it, and about 10% reported a bad reaction to a previous flu shot. Almost no seniors attributed their failure to be immunized to unavailability of the vaccine.

Concluding remarks

A growing number of Canadians are attempting to ward off the annual threat of influenza by getting a flu shot. In 2000/01, 28% of people aged 20 or older reported that they had been vaccinated against flu in the previous year, up from 16% in 1996/97. Most likely to have been immunized were seniors and people with chronic conditions, two of the groups targeted for flu shots by health care authorities since the early 1990s. Nonetheless, among seniors, who tend to be particularly susceptible to the flu and its complications, the overwhelming reason for not being immunized was a belief that it was unnecessary.

In the near future, as the number of Canadians aged 65 or older increases, not being immunized may have consequences for the health care system. The question of how to raise immunization levels has been addressed extensively.[34] Previous studies found that vaccination was more likely on a physician's recommendation,[33,35] and was aided by general practitioners' mailing out a reminder.[32] The results of the analysis of CCHS data show a significantly high rate of immunization for people who have a regular doctor. One approach that has been suggested is to offer influenza immunization as part of any contact with health care providers. ●

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Appendix

Table A
Distribution of selected characteristics, household population aged 20 or older, Canada excluding territories, 2000/01

	Sample size	Estimated population	
		'000	%
Total	30,735	22,623	100.0
Men	14,010	11,075	49.0
Women	16,725	11,548	51.0
Age group			
20-64	24,042	18,958	83.8
65+	6,693	3,665	16.2
Flu shot in last year			
Yes	9,097	6,147	27.2
No	20,806	15,706	69.4
Missing	832	770	3.4
Household income			
Lower	4,057	2,302	10.2
Higher	23,385	18,075	79.9
Missing	3,293	2,245	9.9
Has regular doctor			
Yes	26,357	19,004	84.0
No	4,364	3,610	16.0
Missing	14	F	F
At least one chronic condition†			
Yes	6,852	4,394	19.4
No	23,875	18,222	80.6
Missing	8	F	F
Education			
Less than secondary graduation	8,035	5,009	22.1
Secondary graduation	5,819	4,432	19.6
At least some postsecondary	16,507	12,945	57.2
Missing	374	236	1.0
Smoking			
Never	9,107	7,616	33.7
Former	13,117	8,948	39.6
Daily/Occasional	8,455	6,017	26.6
Missing	56	42	0.2
Self-reported health			
Poor/Fair	4,648	2,791	12.3
Good/Very good/Excellent	26,066	19,823	87.6
Missing	21	F	F
Province			
Newfoundland	818	399	1.8
Prince Edward Island	1,893	100	0.4
Nova Scotia	1,287	689	3.0
New Brunswick	1,089	556	2.5
Québec	4,985	5,531	24.5
Ontario	9,165	8,701	38.5
Manitoba	2,006	787	3.5
Saskatchewan	1,871	688	3.0
Alberta	3,335	2,152	9.5
British Columbia	4,286	3,018	13.3

Data source: 2000/01 Canadian Community Health Survey, fourth quarter
Note: Because of rounding, detail may not add to totals.
† Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke
F Coefficient of variation greater than 33.3%

Table B
Provincial distribution of seniors, population with at least one chronic condition, and household population aged 20 or older, Canada excluding territories, 2000/01

	Age 65 or older			At least one chronic condition			Total population aged 20 or older		
	Sample size	Estimated population		Sample size	Estimated population		Sample size	Estimated population	
		'000	%		'000	%		'000	%
Canada	6,693	3,665	100.0	6,852	4,394	100.0	30,735	22,623	100.0
Newfoundland	126	60	1.6	170	87	2.0	818	399	1.8
Prince Edward Island	453	17	0.5	449	21	0.5	1,893	100	0.4
Nova Scotia	303	118	3.2	334	150	3.4	1,287	689	3.0
New Brunswick	221	92	2.5	258	122	2.8	1,089	556	2.5
Québec	937	894	24.4	1,062	1,050	23.9	4,985	5,532	24.5
Ontario	2,067	1,413	38.6	2,162	1,716	39.1	9,165	8,701	38.5
Manitoba	521	143	3.9	411	144	3.3	2,006	787	3.5
Saskatchewan	514	136	3.7	426	131	3.0	1,871	688	3.0
Alberta	631	288	7.9	670	411	9.4	3,335	2,152	9.5
British Columbia	920	504	13.8	910	561	12.8	4,286	3,018	13.3

Data source: 2000/01 Canadian Community Health Survey, fourth quarter
Note: Because of rounding, detail may not add to totals.
† Asthma, chronic bronchitis/emphysema, diabetes, heart disease, cancer, effects of stroke


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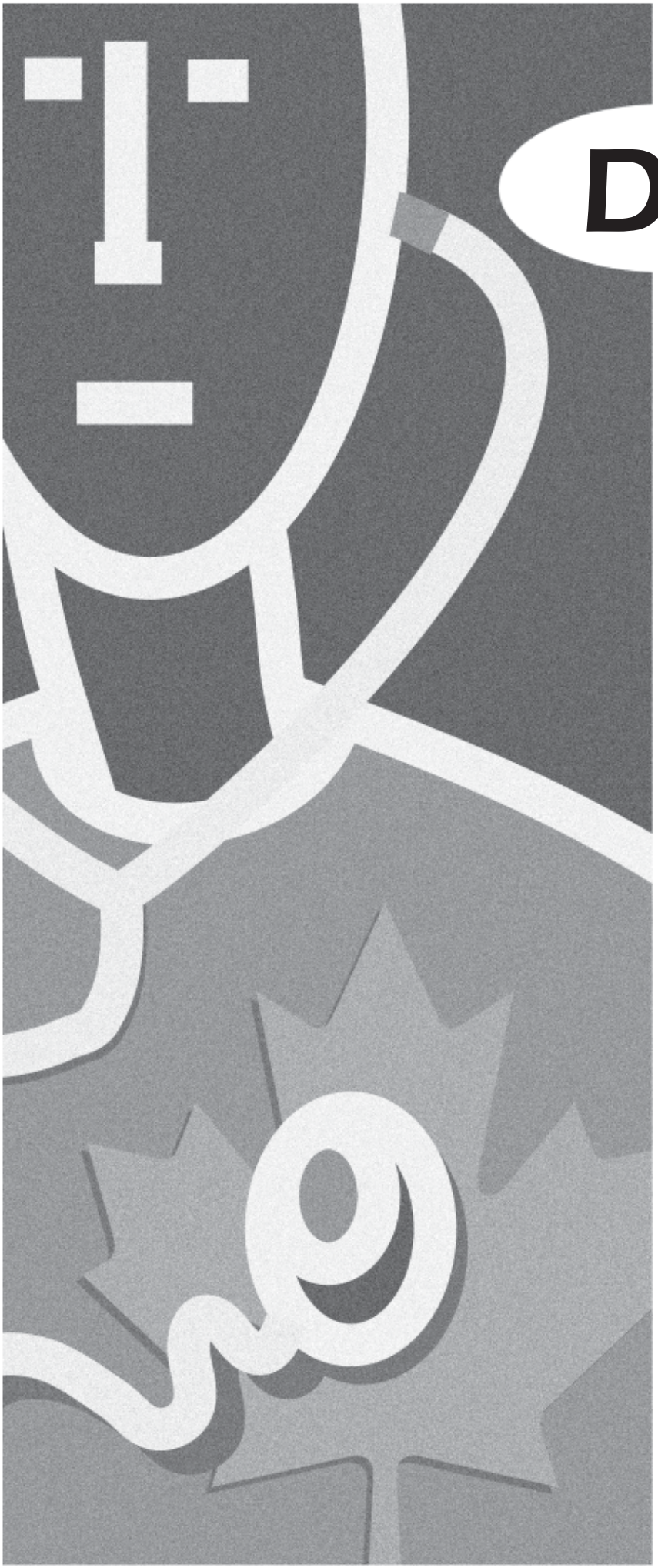

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The latest issue of *Health Indicators* (Volume 2003, Number 2) includes health region income data from the 2001 Census of Population. Tables based on the 2001 Census, the Labour Force Survey, and vital statistics have been revised to reflect the most recent health region boundaries. These data are also presented by "peer group"; that is, health regions with similar socio-economic and demographic characteristics are grouped together. The peer groups have recently been redefined based on the 2001 Census.

Health Indicators, a Web-based publication produced by Statistics Canada and the Canadian Institute for Health Information, measures the health of the Canadian population and the health care system. The indicators are based on standard definitions and methods, and were designed to provide comparable information at the national, provincial/territorial and health region levels.

Health Indicators, Volume 2003, Number 2 (82-221-XIE) is available free online at www.statcan.ca. From the "Our products and services" page, select "Browse our Internet publications," then "Free," followed by "Health." For more information, contact Brenda Wannell (613-951-8554; brenda.wannell@statcan.ca), Health Statistics Division at Statistics Canada, or Anick Losier (613-241-7860), Canadian Institute for Health Information.

Marriages, 2001

In 2001, a total of 146,618 couples married, down 6.8% from 157,395 the previous year. The number of marriages decreased in all provinces and territories except the Northwest Territories and Nunavut. After remaining stable at 5.1 for four years, the crude marriage rate fell to a record low of 4.7 marriages for every 1,000 people in 2001.

Canadians continue to marry later in life. In 2001, the average age of brides was 31.9, and of grooms, 34.4; in both cases, this was 2.6 years older than in 1991. First-time brides and grooms were younger, with average ages of 28.2 and 30.2, respectively, in 2001.

Most 2001 marriage ceremonies were conducted by members of the clergy (76.4%). Marriage commissioners, judges, justices of the peace, clerks of the court or other non-clergy members presided over the remaining 23.6%.

Marriages, 2001 (shelf tables, 84F0212XPB, $22) is now available. For general information, or to order custom tabulations, contact Client Custom Services (613-951-1746; hd-ds@statcan.ca). To enquire about concepts, methods or data quality, contact Patricia Tully (613-951-1759; patricia.tully@statcan.ca) or Brent Day (613-951-4280; brent.day@statcan.ca), Health Statistics Division, Statistics Canada.

Residential care facilities, 1999/2000 to 2001/02

Residential care facilities represented about three-quarters (74%) of the total maximum bed capacity in the health care sector in 2001/02; the remaining 26% of beds were in hospitals. (Because of differences in reporting, these data exclude Québec.)

The maximum bed capacity of residential care facilities in 2001/02 was 188,357 beds, down from 201,009 in 1991/92. Most of this drop is attributable to a decrease in the maximum bed capacity of facilities for the mentally challenged and psychiatrically disabled.

Facilities for the aged represented 77% of the total approved bed complement of all residential care facilities. Occupancy rates in such facilities have been relatively stable over the last 10 years, ranging from 97% to 98% of beds in service.

Direct care costs accounted for 51% of total expenses in facilities for the aged in 2001/02, an increase from 46% in 1991/92. Direct care costs include nursing services, therapeutic services and medications, and exclude meals and administrative expenses.

In 2001/02, the cost per day in facilities for the aged was $115, up from $96 in 1996/97. To a large extent, this increase reflects rising costs in public facilities, which went from $105 per resident-day in 1996/97 to $130 in 2001/02. Over the same period, the cost per day in private facilities rose from $80 to $95.

Costs also increased for other residential care facilities (for people with disabilities, developmental delays, psychiatric disabilities or alcohol and drug addictions, or for delinquents, transients, or children with emotional disturbances). The cost per resident-day was $158 in 2001/02, compared with $134 in 1996/97. Direct care costs in these facilities accounted for 69% of total expenses in 2001/02, up from 58% in 1991/92.

For more information, or to enquire about concepts, methods or data quality, contact Richard Trudeau (613-951-8782; richard.trudeau@statcan.ca) or Client Custom Services (613-951-1746; hd-ds@statcan.ca), Health Statistics Division, Statistics Canada.

Deaths, 2001

Life expectancy at birth rose slightly in 2001, to new highs for both sexes. A woman born in 2001 could expect to live 82.2 years, an increase of 0.2 years over 2000. A man's life expectancy at birth reached 77.1 in 2001, up 0.3 years. Life expectancy for both sexes combined was 79.7.

The life expectancy gap between the sexes narrowed from 5.2 years in 2000 to 5.1 years in 2001. This narrowing has continued for over 20 years. Since 1979, life expectancy for men improved by 5.7 years; for women, by 3.4 years.

A total of 219,538 people died in 2001, a 0.7% increase from 218,062 in 2000. While only Québec, Alberta, British Columbia and the Northwest Territories recorded more deaths in 2001 than in 2000, these increases were large enough to offset declines in the number of deaths in the other provinces and territories.

Because growth of the Canadian population outpaced the number of deaths, the crude death rate (the number of deaths per 100,000 population) held steady at 7.1.

The infant death rate fell slightly in 2001 to 5.2 deaths per 1,000 live births. The maternal mortality rate rose to 7.8 maternal deaths per 100,000 live births. This rate represented only 26 deaths, but it is the highest rate since 1982. A maternal death is the death of a woman while pregnant or within one year of the termination of a pregnancy as a result of related complications.

Influenza deaths in 2001 were down a striking 83.8% from the previous year. Fewer than 100 people died as a result of influenza in 2001, compared with more than 500 in 2000.

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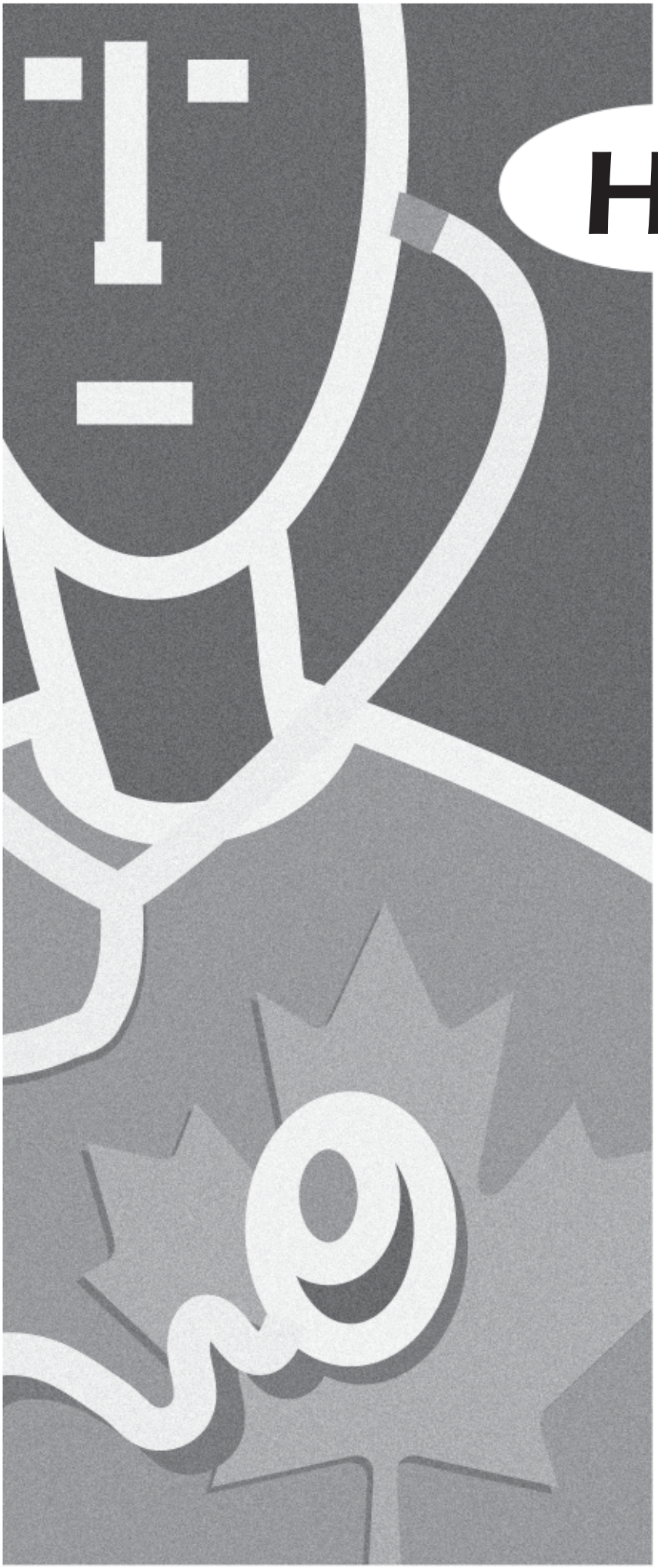

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Custom tables	Household	82C0013	Price varies with information requirements	
Cycle 3, 1998-99				
Household	Cross-sectional data in Flat ASCII files, User's Guide, data dictionary, indexes, layout, Beyond 20/20 Browser for the Health File	82M0009XCB	CD-ROM	$2,000
Custom tables	Household Institutions	82C0013 82C0015	Price varies with information requirements. Price varies with information requirements.	
Cycle 2, 1996-97				
Household	Cross-sectional Flat ASCII Files, Beyond 20/20 Browser for the Health File	82M0009XCB	CD-ROM	$500
Health care institutions	Cross-sectional Flat ASCII File	82M0010XCB	CD-ROM Clients who purchase the 1996/97 Household file will receive the Institutions file free of charge.	$250
Custom tables	Household Institutions	82C0013 82C0015	Price varies with information requirements. Price varies with information requirements.	
Cycle 1, 1994-95				
Household	Data, Beyond 20/20 Browser Flat ASCII Files, User's Guide	82F0001XCB	CD-ROM	$300
Health care institutions	Flat ASCII Files	82M0010XDB	Diskette	$75
Custom tables	Household Institutions	82C0013 82C0015	Price varies with information requirements. Price varies with information requirements.	

† All prices exclude sales tax.
‡ See inside cover for shipping charges.

POPULATION HEALTH SURVEYS

Canadian Community Health Survey (CCHS)

Cycle 1.1: CCHS was conducted by Statistics Canada to provide cross-sectional estimates of health determinants, health status and health system utilization for 133 health regions across Canada, plus the territories.

Cycle 1.2: CCHS-Mental Health and Well-being is being conducted by Statistics Canada to provide provincial cross-sectional estimates of mental health determinants, mental health status and mental health system utilization.

Cycle 2.1: CCHS will be conducted by Statistics Canada to provide cross-sectional estimates of health determinants, health status and health system utilization for 134 health regions across Canada.

National Population Health Survey (NPHS)

Household - The household component includes household residents in all provinces, with the principal exclusion of populations on Indian Reserves, Canadian Forces Bases and some remote areas in Québec and Ontario.

Institutions - The institutional component includes long-term residents (expected to stay longer than six months) in health care facilities with four or more beds in all provinces with the principal exclusion of the Yukon and the Northwest Territories.

North - The northern component includes household residents in both the Yukon and the Northwest Territories with the principal exclusion of populations on Indian Reserves, Canadian Forces Bases and some of the most northerly remote areas of the Territories.

Joint Canada - United States Health Survey (JCUHS)

The Joint Canada - United States Health Survey (JCUHS) will collect information from both Canadian and U.S. residents, about their health, their use of health care and their functional limitations.

For more information about these surveys, visit our web site at
http://www.statcan.ca/english/concepts/hs/index.htm

Canadian Statistics

Obtain free tabular data on aspects of Canada's economy, land, people and government.

For more information, visit our web site at http://www.statcan.ca, under "Canadian Statistics," and then click on "Health."

Statistical Research Data Centres

Statistics Canada, in collaboration with the Social Sciences and Humanities Research Council (SSHRC), has launched an initiative that will help strengthen the country's social research capacity, support policy-relevant research, and provide insights on important issues to the Canadian public. The initiative involves the creation of nine research data centres at McMaster University in Hamilton, the Université de Montréal, Dalhousie University, and the Universities of Toronto, Waterloo, Calgary, Alberta, New Brunswick (Fredericton), and British Columbia. Prospective researchers who wish to work with data from the surveys must submit project proposals to an adjudicating committee operating under the auspices of the SSHRC and Statistics Canada. Approval of proposals will be based on the merit of the research project and on the need to access detailed data. The centres and research projects will be evaluated periodically to assess security standards and the success of analysis resulting from the projects. Researchers will conduct the work under the terms of the *Statistics Act*, as would any other Statistics Canada employee. This means that the centres are protected by a secure access system; that computers containing data will not be linked to external networks; that researchers must swear a legally binding oath to keep all identifiable information confidential; and that the results of their research will be published by Statistics Canada. For more information, contact Garnett Picot (613-951-8214), Business and Labour Market Analysis Division.