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Summer 1997 Volume 9 No. 1

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Note from the Editor-in-Chief

Volume 9 marks the beginning of a new design for *Health Reports* and a further refinement of our style. The redesign was initiated and managed by Jason Siroonian. The project team included Mary Sue Devereaux, Renée Bourbonnais, Bernie Edwards, and Hélène Aylwin. Allium Consulting Group Inc. created the design. We hope that you find our new appearance attractive and easy to read.

Research Articles

This section presents in-depth research and analysis in the fields of health and vital statistics.

Gender differences in abdominal aortic aneurysm surgery

Greg F. Parsons, Jane F. Gentleman and K. Wayne Johnston

Abstract

Objectives

This article analyzes abdominal aortic aneurysm (AAA) surgery rates by sex for inpatients of Canadian hospitals. Possible reasons for the observed gender differences in surgery rates are discussed.

Data source

For fiscal years 1983/84 to 1993/94, over 100,000 hospitalization records for patients aged 45 and over with an AAA were extracted from the Hospital Morbidity File maintained by Statistics Canada.

Analytical techniques

Surgery rates were calculated by sex for hospitalizations involving non-ruptured and ruptured AAAs. To control for sex differences in AAA prevalence and hospitalization rates, surgery rates were based on the population of hospital inpatients with AAA.

Main results

Rates of elective and emergency AAA surgery were consistently and substantially lower for women than men.

Conclusion

Gender differences in AAA prevalence, hospitalization rates, age, and contraindications for surgery cannot explain the differences in surgery rates between women and men. Possible gender bias in the decision to operate could not be ruled out.

Key words

elective surgery, emergency surgery, gender bias

Authors

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In fiscal year 1993/94, about 11,000 hospitalizations in Canada involved an abdominal aortic aneurysm (AAA)—a localized dilation of the main artery in the abdominal region. In most cases, an AAA is not accompanied by symptoms, and a diagnosis is often made coincidentally either by palpation of the abdomen or by ultrasound. Sometimes, abdominal or back pain can draw attention to an aneurysm. Regardless of the path to diagnosis, once a significant non-ruptured AAA has been identified, there is an opportunity to perform surgery to eliminate the chance of rupture and thus reduce the likelihood of death.

From 1991 to 1993, over 1,000 deaths per year were attributed to AAA.[1] However, the number of AAA deaths is likely underestimated, since some of them were probably ascribed to other causes of sudden death such as myocardial infarction.

Methods

Data source

Data on 103,488 hospital stays involving AAA for fiscal years 1983/84 to 1993/94 were taken from Statistics Canada's Hospital Morbidity File.[2] The file contains one record for each separation from Canadian general and allied special hospitals in all provinces, excluding specialized psychiatric and mental hospitals and most services received in military and prison hospitals. The coverage of the file is virtually complete.

"Separation" refers to the discharge or death of a hospital patient. Each record contains up to five diagnosis codes and up to three surgical procedure codes.

Analytical techniques

A hospitalization involving an AAA was defined as a separation record with either of two ICD-9 codes for abdominal aortic aneurysm in any of the diagnosis fields: 441.3 (abdominal aortic aneurysm, ruptured) or 441.4 (abdominal aortic aneurysm, without mention of rupture).[3] ICD-9 codes 441.5 (aortic aneurysm of unspecified site, ruptured) and 441.6 (aortic aneurysm of unspecified site, without mention of rupture) were excluded. The number of records with the last two codes was less than 4% of the total number of separations involving AAA for each of ruptured and non-ruptured cases.

An operation involving the aorta was defined as a record with at least one of the following Canadian Classification of Procedure (CCP) codes in any of the surgical procedure fields: 50.24 (resection of the aorta with anastomosis), 50.34 (resection of the aorta with replacement), 50.54 (other excision of the aorta), 51.25 (aorta-iliac-femoral bypass), or 51.52 (other repair of aneurysm).[4]

Records with the following codes were considered to represent stays involving elective and emergency AAA surgery:

Elective AAA surgery:	ICD-9 = 441.4 (non-ruptured) and CCP = 50.24 or 50.34 or 50.54 or 51.25 or 51.52
Emergency AAA surgery:	ICD-9 = 441.3 (ruptured) and CCP = 50.24 or 50.34 or 50.54 or 51.25 or 51.52

For the population aged 45 and over, frequencies of hospitalizations involving a diagnosis of AAA were tabulated by sex and age group, by whether the ICD-9 codes indicated a ruptured AAA, and by whether the CCP codes indicated aortic surgery.

Annual age-sex-specific surgery rates were calculated at the national level (excluding the two territories) for both elective and emergency surgery. To control for gender differences in AAA prevalence and hospitalization rates, surgery rates were calculated based on the population of hospital inpatients with AAA. For elective surgery, rates were calculated as the number of hospital stays involving elective AAA operations divided by the number of hospitalizations involving a diagnosis of non-ruptured AAA. The emergency surgery rates were calculated as the number of hospitalizations involving emergency AAA operations divided by the number of hospitalizations involving a diagnosis of ruptured AAA.

Surgery rates by sex were age-standardized. For elective surgery, the standard population was the national population of inpatients with a non-ruptured AAA, combined across sexes and fiscal years 1983/84 to 1993/94. For emergency surgery, the standard population was defined similarly for inpatients with a ruptured AAA.

Limitations

The Hospital Morbidity File does not contain information about AAA size or the severity of diagnosed conditions, two factors that may partly explain the gender differences in elective surgery rates. AAA size is not relevant in comparing emergency surgery rates.

The frequencies presented in this article refer to the number of hospital stays involving AAA, not the number of patients. An individual may be hospitalized more than once during a year because of an AAA. Moreover, the principal reason for hospital admission cannot always be reliably identified among the diagnostic and surgical codes on the separation record, so in some cases, the AAA diagnosis could be incidental.[5,6] For example, a woman could be admitted to hospital for suspected coronary heart disease, be found to also have a small AAA, and be released without AAA surgery. If the same woman was readmitted to hospital within the same fiscal year, her two stays involving AAA would be counted separately in calculating AAA surgery rates, because the hospital data are organized by hospital stay, not by individual patient.

If a non-ruptured AAA is diagnosed and repaired early, the prognosis is good. The operative mortality rate for strictly elective AAA surgery is generally below 5%.[7,8] When symptomatic and/or urgent cases are included, this rate rises to about 10%.[9,10]

If an AAA is undiagnosed or left untreated, additional enlargement will further weaken the wall of the artery, increasing the likelihood of rupture. In the event of a rupture, most patients will die before reaching hospital.

For those who undergo emergency surgery to repair a ruptured AAA, the operative mortality rate is about 50%.[7,8] Sadly, in some cases, a patient with a ruptured AAA may make it to hospital but other factors may preclude surgery. Estimates of the mortality rate after rupture—including cases not taken to hospital—have ranged from 80% to 95%.[11,12] Clearly, early diagnosis and elective surgery, when indicated, are important in reducing AAA mortality.

Among those admitted to hospital, women are less likely than men to receive elective and emergency AAA surgery. These differences in surgery rates may stem from surgical guidelines that may not be equally valid for women and men. Or, the discrepancy may be explained by differences between women and men with AAAs with respect to the presence of accompanying conditions that may contraindicate surgery. Or, gender bias could be involved in the decision to operate for AAA.

Outside Canada

In Australia (1971-81),[13] Scotland (1971-84),[14] and Michigan (1980-90),[15] a smaller proportion of women than men diagnosed with an AAA proceeded to surgery. The Australian study reported that 35% of female patients but 53% of male patients with an AAA received surgical repair in 1980/81. The Scottish study reported that only 26% of women but 49% of men with an AAA had surgery in 1984. The American study found that during the 1980 to 1990 period, surgery rates for male inpatients with non-ruptured and ruptured AAAs were, respectively, 80% and 40% higher than for female inpatients. The authors concluded that it remained to be determined whether these gender differences were the result of clinical practice patterns or biological factors.

Using data from Statistics Canada's Hospital Morbidity File, this article analyzes AAA surgery rates for hospital inpatients by sex from 1983/84 to 1993/94 (see *Methods*). Possible reasons for the gender differences in surgery rates are discussed.

Previous studies have suggested the possibility of gender bias in the management of AAA (see *Outside Canada*), as well as of other medical conditions. Examples of the latter are the application of diagnostic and revascularization procedures for coronary heart disease, referral for suspected Parkinson's disease, and the use of venous ultrasonography for the diagnosis of deep venous thrombosis.[16-23]

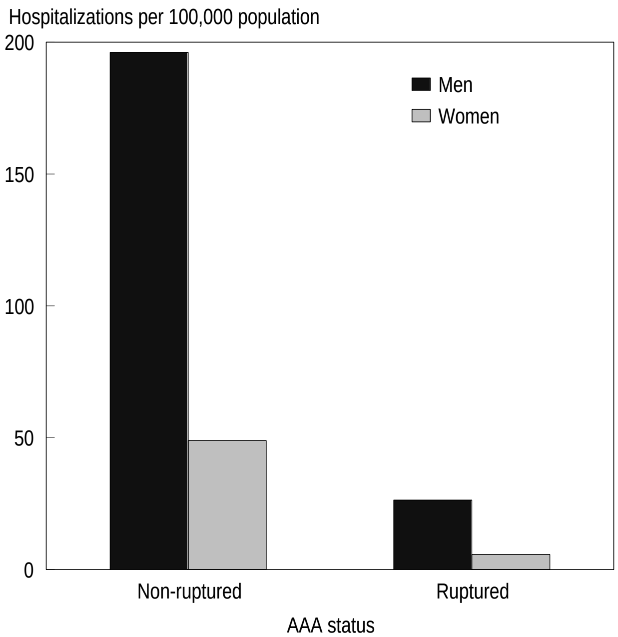
Who is at risk?

AAAs are most prevalent among the elderly and rarely occur in young people. In 1993/94, Canadians aged 65 and over experienced the majority (83%) of hospitalizations involving an AAA, and virtually all individuals hospitalized with an AAA were aged 45 and over. Consequently, the analysis presented here is restricted to hospital inpatients aged 45 and over.

AAA does not afflict both sexes equally. Prevalence rates for men are typically five or six times those for women.[15,24,25] In 1993/94, men accounted for 75% of AAA hospitalizations, and hospitalization rates for men were four or five times those for women (Chart 1). Understandably, more deaths among men than among women have AAA as the underlying cause.[15,24-26]

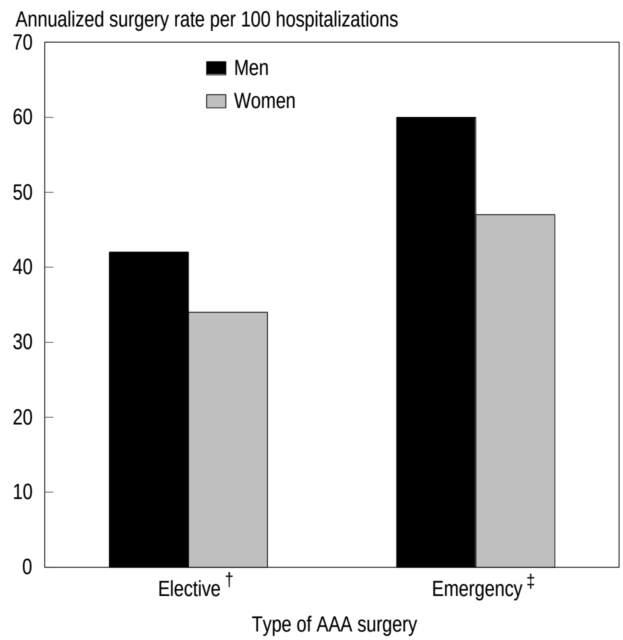
Between 1983/84 and 1993/94, age-standardized non-ruptured AAA hospitalization rates increased substantially for men, from 146 to 196 per 100,000 population. The rates for women rose less sharply from 40 to 49. Hospitalizations for men with ruptured AAA decreased (from 32 to 26 between 1983/84 and 1993/94) and were quite stable for women (5.6 and 5.7, respectively). As the population ages, the frequency of AAA hospitalizations is expected to increase further.

Chart 1
Age-standardized hospitalization rates involving AAA, by sex, age 45 and over, Canada, 1993/94



Data source: *Hospital Morbidity File*
Note: *Age-standardized to the 1991 Canadian population*

Chart 2
Age-standardized AAA surgery rates, by sex, age 45 and over, Canada, 1983/84 to 1993/94 combined



Data source: *Hospital Morbidity File*
Note: *Age-standardized to the hospitalized population involving non-ruptured or ruptured AAA, 1983/84 to 1993/94 combined*
† Rate per 100 non-ruptured AAA inpatients
‡ Rate per 100 ruptured AAA inpatients

Table 1
AAA hospitalizations and surgery rates, age 45 and over, Canada, 1983/84 to 1993/94

	Non-ruptured AAA				Ruptured AAA			
	Number of hospitalizations		Elective surgery rate†		Number of hospitalizations		Emergency surgery rate‡	
	Men	Women	Men	Women	Men	Women	Men	Women
			Per 100 hospitalizations				Per 100 hospitalizations	
Total	**66,840**	**22,743**	**41.8§**	**33.9§**	**11,023**	**2,882**	**59.8§**	**46.5§**
1983/84	4,381	1,552	40.1	33.3	940	222	58.4	51.0
1984/85	4,637	1,739	41.4	33.5	919	224	56.8	45.0
1985/86	5,079	1,786	41.6	33.9	978	244	58.3	35.3
1986/87	5,710	1,875	42.2	34.9	962	226	59.3	41.5
1987/88	6,110	2,089	41.3	34.8	1,024	237	60.6	44.9
1988/89	6,477	2,039	42.4	32.7	1,033	276	59.2	51.0
1989/90	6,280	2,173	41.8	33.5	1,031	242	63.4	49.7
1990/91	6,588	2,193	43.0	34.7	1,023	280	60.2	51.0
1991/92	7,007	2,327	42.4	35.8	1,066	288	63.7	47.7
1992/93	6,913	2,358	41.7	32.7	1,029	328	59.2	48.1
1993/94	7,658	2,612	41.0	33.3	1,018	315	59.8	46.5

Data source: *Hospital Morbidity File*
† Age-standardized to the hospitalized population involving non-ruptured AAA, 1983/84 to 1993/94 combined
‡ Age-standardized to the hospitalized population involving ruptured AAA, 1983/84 to 1993/94 combined
§ Annualized rate over 11 years

Elective surgery

Among those admitted to hospital, women are less likely than men to receive elective AAA surgery (Chart 2). From 1983/84 to 1993/94, the annualized age-standardized elective surgery rate for women was 34 per 100 hospitalizations. For men, the rate was higher at 42 per 100 hospitalizations (Table 1). This gender difference in elective surgery rates persists across all age groups (Chart 3).

Emergency surgery

Similarly, women admitted to hospital with a ruptured AAA are less likely than male inpatients to receive emergency surgery (Chart 2). From 1983/84 to 1993/94, women's emergency surgery rates fluctuated around 50 per 100 hospitalizations, excluding a substantial dip from 1984/85 to 1987/88. (This temporary decline at the national level was the result of unexplained lower rates for women in the Atlantic region, Quebec, and Ontario.) Men's surgery rates centred around 60 per 100 hospitalizations. Lower emergency AAA surgery rates for women were evident across all age groups.

Explaining the differences

If multiple AAA hospitalizations during one year were more common for women than men, this could decrease elective surgery rates for women relative to men. This appears not to be the case. Crude rates based on patient-linked hospital morbidity data for 1992/93 and 1993/94 show similar rates of multiple AAA hospitalizations for women and men. Of the persons with at least one hospital stay involving an AAA diagnosis, 15% of the women and 16% of the men had more than one stay involving AAA. Multiple hospitalizations are not an issue with ruptured AAAs and thus, cannot explain gender differences in emergency surgery rates.

Patients are able to affect the decision to operate. In two recent studies, one involving cardiac defibrillator implantation and the other involving cardiac transplant, women showed a significantly lower rate of acceptance of surgical therapy than did men.[27,28] However, it seems unlikely that differential acceptance rates could explain the AAA surgery rate differences, especially those for emergency surgery.

As has been previously suggested, gender bias may contribute to differences in AAA surgery rates. This article examines that possibility by considering three hypotheses:

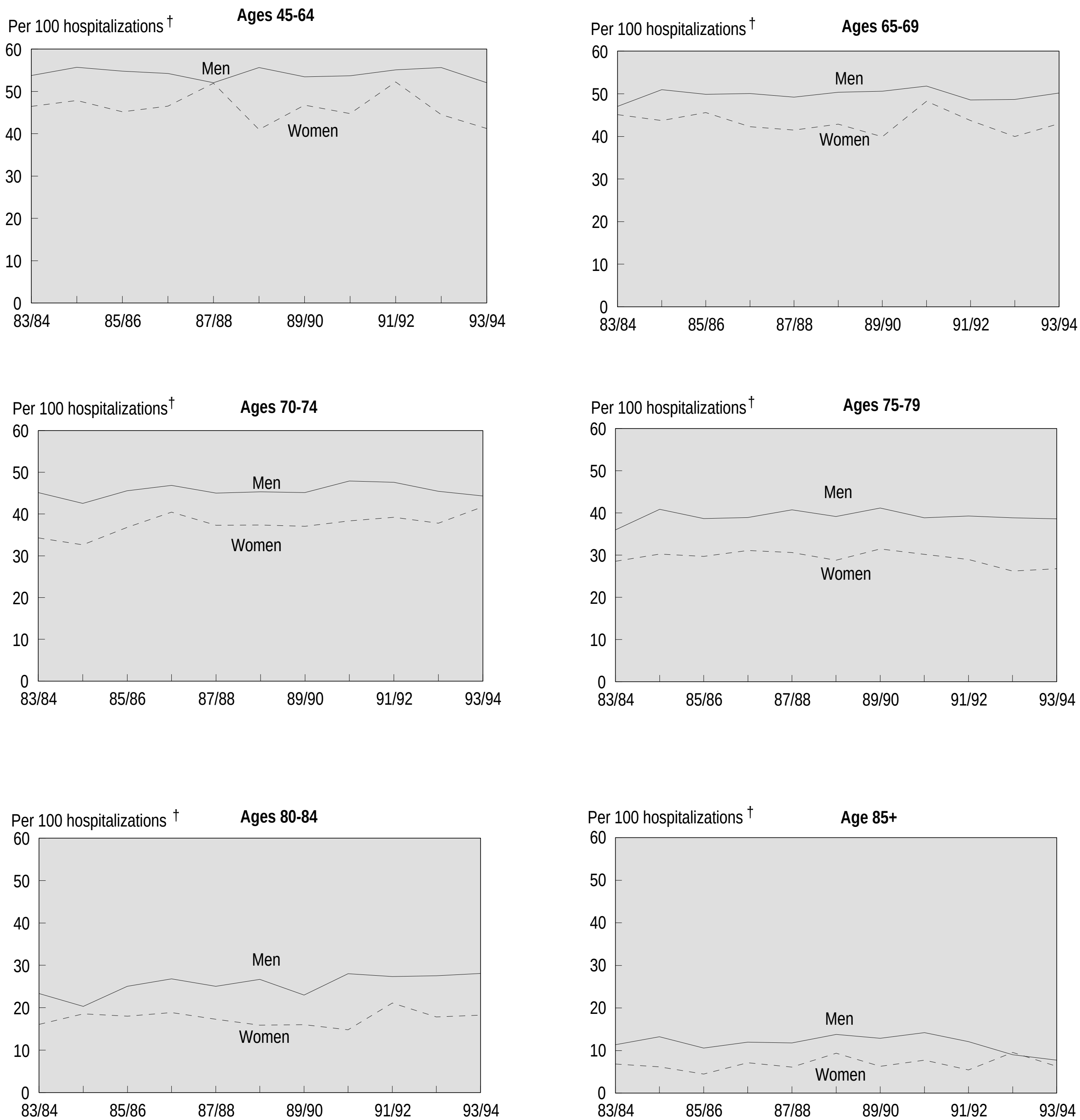
- the criteria used to make the decisions to operate were equally valid for women and men;
- the medical conditions of female and male AAA inpatients were similar with respect to contraindications for surgery;
- the decisions to operate, which were based on both the criteria for surgery and the medical conditions of AAA inpatients, were unbiased.

Surgery rates could be expected to be approximately the same for women and men if all three hypotheses were true.

Criteria for surgery

The criteria used to determine if surgery for a non-ruptured AAA is indicated may depend on several factors: the size of the AAA, either in absolute terms or relative to the normal infrarenal aorta; the rate of expansion of the aneurysm; and contraindications for surgery. In 1992, an expert committee recommended indications for AAA surgery (see *Surgical guidelines*).[29] These and previous recommendations do not explicitly consider the sex of the patient, although the aorta of a woman is generally smaller than that of a man.[30] While the use of relative AAA size as a criterion (for example, more than twice the diameter of the normal infrarenal aorta) would adjust for natural size differences between women and men, measures of absolute size (for example, greater than 4 cm in diameter) are the standard approach in research and clinical practice.[30] However, one study reported that criteria involving the absolute size of the AAA have sometimes been applied differentially by sex, with surgery being performed at a smaller AAA size for women.[31]

Chart 3
Age-sex-specific elective AAA surgery rates, Canada, 1983/84 to 1993/94



Data source: *Hospital Morbidity File*
† Involving non-ruptured AAAs

In a woman and a man of the same age, each with a non-ruptured AAA, the aneurysm in the woman is likely to be smaller, because women's aortas are generally smaller, and women who develop an AAA tend to do so later in life than men. It is possible that AAA size differences could explain some of the differences in age-specific elective surgery rates. However, differences in age of onset cannot explain them, as elective surgery rates are lower not just for women in the same age group as men, but also for women in older age groups (Table 2 and Chart 3). In the case of a ruptured AAA, size differences are irrelevant and cannot explain gender differences in age-specific emergency surgery rates.

Surgical guidelines

A sub-committee of the Joint Council of the Society for Vascular Surgery and the North American Chapter of the International Society for Cardiovascular Surgery specified as indications for elective surgery that the AAA be greater than 4 cm in diameter, or more than twice the diameter of the normal infrarenal aorta.[29] A six-month expansion rate of 0.5 cm or more was identified as a supplementary indication.

For aneurysms between 4 and 5 cm, these guidelines specify a variety of comorbid conditions that may justify not offering AAA repair: myocardial infarction in the previous six months, intractable congestive heart failure, severe angina pectoris, severe kidney dysfunction, decreased mental acuity, and markedly advanced age. Cerebrovascular disease and severe pulmonary insufficiency have also been documented as additional operative risk factors.[32-34] For aneurysms exceeding 5 cm, the guidelines indicate that the medical comorbid condition must be considerably worse to preclude elective surgery (that is, life expectancy of less than two years, overwhelming medical problems, or the expectation of an unacceptable quality of life).

For a ruptured AAA, surgery is generally offered unless there are significant comorbid conditions that would limit the patient's life span or quality of life. "Most vascular surgeons recommend repair for all symptomatic or ruptured AAA ... in the absence of overwhelming contraindications."[35]

Although there is general agreement that a diagnosed or suspected rupture is sufficient indication for emergency surgery, there is disagreement about the contraindications. The sub-committee listed only preterminal conditions that preclude long-term survival (for example, cancer), and conditions relating to quality of life that make repair unreasonable (for example, dementia).

Medical condition of AAA inpatients

If female inpatients, compared with male inpatients, had more accompanying conditions or illnesses that preclude AAA surgery, this might also explain some of the gender differences in surgery rates.

From prior research, seven diagnoses were chosen that may contraindicate elective AAA surgery (Table 3).[29-32,35] As expected, rates of elective AAA surgery were lower when one or more of these conditions were present. Hospitalized women with a non-ruptured AAA were somewhat more likely than men to have one or more of these conditions. At least one of the seven occurred among 26% of the women, compared with 23% of the men. However, among patients free of all these comorbid conditions, elective surgery rates were still lower for women (Table 2).

From hospital records, 19 diagnoses were identified that might have been considered contraindications for emergency surgery (Table 4). For each of these potential contraindications, a majority of hospital patients with a ruptured AAA and that accompanying diagnosis did not receive emergency surgery. Women with a ruptured AAA were slightly more likely than men to have one or more of the identified comorbid conditions. At least one of these diagnoses appeared on 52% of the records for women, compared with 50% of the records for men. But even among patients with none of these conditions, lower emergency surgery rates persisted for women (Table 2).

Thus, although female AAA patients do appear to be more likely to have accompanying illnesses that may contraindicate surgery, the differences in the prevalences of these conditions among AAA inpatients are appreciably smaller than the gender differences in surgery rates.

It is also possible that gender differences in the severity of comorbid conditions (which cannot be determined from the available data) could explain some of the gender differences in AAA surgery rates. But in light of the persistence of gender differences in both elective and emergency surgery rates for patients with none of these comorbid conditions, gender bias cannot be ruled out.

Is gender bias involved?

Studies in other countries have found gender differences in the decision to operate for AAA. Also, a recent study by Johnston, reporting for the Canadian Vascular Surgery Aneurysm Study Group, argued that evidence in the literature suggests a gender bias in the diagnosis of AAA and/or patient selection for AAA surgical treatment.[7] The proportions of women in surgical series for repair of non-ruptured and ruptured AAA were generally less than the proportions of women having AAA who were identified in autopsy studies, ultrasound studies, hospital discharge data and national mortality data. Two possible explanations were provided: the difference may reflect a gender bias, and for women, the prevalence of AAA is highest among the elderly, who may not be considered for repair due to their age and/or comorbid conditions.

Concluding remarks

The data strongly confirm differences between AAA surgery rates for women and men. Women have substantially lower elective and emergency AAA surgery rates, and these differences persist in all age groups and throughout the 11-year period of analysis. In attempting to account for these differences, this study could not rule out the possibility of gender bias.

Reasons suggested for the apparent tendency to be less aggressive in treating women with an AAA as opposed to men include: the perception that the disease is more benign in women; that

Table 2
AAA surgery rates, by presence of accompanying diagnoses, age group and sex, Canada, 1983/84 to 1993/94

	One or more accompanying diagnoses present			None of accompanying diagnoses present		
	Age group			Age group		
	45-64	65-79	80+	45-64	65-79	80+
	Per 100 hospitalizations					
Elective surgery†						
Men	37	31	14	58	49	24
Women	28	22	7	51	41	15
Emergency surgery‡						
Men	66	60	43	75	67	48
Women	43	45	27	63	56	36

Data source: *Hospital Morbidity File*
† See diagnoses listed in Table 3; rate per 100 non-ruptured AAA inpatients
‡ See diagnoses listed in Table 4; rate per 100 ruptured AAA inpatients

Table 3
Selected accompanying diagnoses that may contraindicate elective AAA surgery

Diagnosis	ICD-9 code
Senility, other cerebral degenerations	290,331
Myocardial infarction	410-412
Angina pectoris	413
Diseases of pulmonary circulation	415-417
Heart failure	428
Cerebrovascular disease	430-438
Renal failure and disorders resulting from renal dysfunction	584-588

Table 4
Selected accompanying diagnoses that may contraindicate emergency AAA surgery

Diagnosis†	ICD-9 code
Malignant neoplasms	140-208
Disorders of fluid, electrolyte and acid-base balance	276
Obesity and other hyperalimentation	278
Other and unspecified anemias	285
Hypertensive heart disease	402
Acute myocardial infarction	410
Old myocardial infarction	412
Other forms of chronic ischaemic heart disease	414
Cardiac dysrhythmias	427
Heart failure	428
Late effects of cerebrovascular disease	438
Atherosclerosis	440
Other peripheral vascular disease	443
Other disorders of circulatory system	459
Pneumonia, organism unspecified	486
Emphysema	492
Chronic airways obstruction, not elsewhere classified	496
Pleurisy	511
Chronic renal failure	585

Data source: *Hospital Morbidity File*
† Majority of inpatients with ruptured AAA accompanied by the diagnosis did not have surgery

intervention is more hazardous in women; and that AAA is mostly a disease of men.[15] Whatever the reason, a lower likelihood of referral of women for elective AAA surgery could increase their likelihood of death from a ruptured AAA.

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Who doesn't get a mammogram?

Jane F. Gentleman and Judy Lee

Abstract

Objectives
This article examines the characteristics associated with getting or not getting a mammogram, focusing on women aged 50-69.

Data source
The data are from the 1994/95 National Population Health Survey conducted by Statistics Canada.

Analytical techniques
Multivariate logistic regressions were run to determine the odds of ever having had a mammogram, and among women who had, the odds of having done so in the last two years.

Main results
In 1994/95, 75% of Canadian women aged 50-69 had had a mammogram at some time, but a quarter of those who ever had one had not done so within the previous two years, as is recommended. Characteristics significantly associated with having had a mammogram were province of residence, contact with a physician, marital status, educational attainment, employment status, and country of birth.

Conclusion
The characteristics of women aged 50-69 who have never received a mammogram, or have not done so as often as recommended, indicate the groups to whom programs encouraging compliance should be directed.

Key words
mammography, breast cancer, mass screening

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The use of mammography to detect breast cancer has grown dramatically, especially after mammographic screening was linked to decreased breast cancer mortality.[1] From just 162,000 mammograms in 1981, the annual number performed in Canada rose to approximately 1.4 million in 1994.[2]

The Canadian Cancer Society recommends that women aged 50-69 have a mammogram every two years. According to Statistics Canada's 1994/95 National Population Health Survey (NPHS), three-quarters of women in this age group had had at least one mammographic examination. However, this left more than 630,000 women aged 50-69 who had never had a mammogram. As well, almost one-quarter of the women who had had a mammogram had not done so in the previous two years.

With data from the 1994/95 NPHS, this article identifies demographic and socioeconomic characteristics and health practices associated with women aged 50-69 getting, or not getting, a mammogram (see *Methods*). The analysis counts all

Methods

Data source

The data used in this article are from Statistics Canada's 1994/95 National Population Health Survey (NPHS).[3] Female respondents aged 35 and over were asked, "Have you ever had a mammogram, that is, a breast x-ray?" Those who answered "yes" were asked, "When was the last time?"

This analysis focuses on respondents in the age group now targeted for mammograms (ages 50-69) who answered the first question. These 2,111 respondents represented 2,551,674 non-institutionalized women in the 10 Canadian provinces. Some information is also presented for women aged 40-49 (1,471 respondents, representing 2,002,949 non-institutionalized women). Respondents with unknown mammogram histories were excluded.

The survey enquired about all mammograms and did not distinguish between those received in organized breast screening programs and those received from other sources.

New Brunswick, Manitoba, and Newfoundland began organized screening programs after NPHS data were collected. Therefore, this analysis does not reflect the effects that these programs may have had on mammography rates.

Starting dates of provincial breast screening programs and timing of the National Population Health Survey (NPHS)

Province	Starting date
British Columbia	July 1988
Saskatchewan	April 1990
Ontario	June 1990
Alberta	October 1990
Nova Scotia	June 1991
NPHS: June 1994 -June 1995	
New Brunswick	June 1995
Manitoba	July 1995
Newfoundland	January 1996
Prince Edward island	...
Quebec	...

Analytical techniques

Multivariate logistic regressions were run to predict the odds of ever having had a mammogram, as well as the odds, among women who had had a mammogram, of having done so in the last two years. Most of the independent variables were based on demographic and socioeconomic characteristics and health practices identified in earlier studies as being associated with mammographic utilization. The regressions were weighted to represent the Canadian population by rescaling the survey weights to sum to the number of survey respondents.

The independent variables in the regressions were marital status, province, residence/non-residence in a census metropolitan area (CMA), education, household income, main activity, place of birth, physician contact in the last year, and having cancer. CMAs are urban centres with at least 100,000 inhabitants in their urbanized core. There are 25 CMAs in Canada.[4] Household income is a derived measure of income adequacy based on household size. Main activity refers to the principal way in which the respondent reported spending most of her time. Physician contact was recorded if the woman had seen or talked on the telephone to a general practitioner in the last 12 months. The cancer variable was included in the model to adjust the other results for whether or not the woman had this disease. A respondent who had ever had cancer was not recorded as having it at the time of the survey if the diagnosis occurred at least five years earlier, and she had been told that the disease was cured.

Limitations

Mammography data from the NPHS are subject to the problems inherent in self-reported data. Women who agree to participate in a survey such as the NPHS may be more likely than non-respondents to have engaged in health-promoting behaviour such as having a screening mammogram. Some respondents may wish to provide a socially desirable answer, and so may have said that they had had a mammogram, when in fact, they had not. Also, some respondents may have replied affirmatively, assuming that a chest x-ray or other breast examination was actually a mammogram. As well, respondents might not have remembered the exact date of their last mammogram.[2]

mammograms, not just those received in formal screening programs, and thus assesses the combined results of all efforts to encourage compliance with the recommendations.

Factors associated with getting a mammogram that have been identified in previous studies include age, race, income, education, location of residence, physician advice, knowledge about health maintenance, and medical coverage.[5-14] This analysis of NPHS data shows that the likelihood of women in the targeted age group having mammograms varies significantly by marital status, province, educational attainment, employment status, country of birth, recency of physician contact, and a diagnosis of cancer. Some of these variables have a much stronger effect on mammographic utilization than do others, and so have implications for reaching women who have been targeted but have not been screened.

Breast cancer

The most recent actual data show that breast cancer mortality among women aged 50-69 is declining (see *Update on breast cancer mortality, 1995* in this issue).[15] Nonetheless, an estimated 3,600 women in their fifties will be diagnosed with the disease in 1997 and 810 will die from it.[16] The estimated 1997 incidence rate is 240 new cases per 100,000 women aged 50-59, and the mortality rate is 54 deaths per 100,000. Among women in their sixties, numbers and rates are higher, with 4,400 new cases and 1,050 deaths anticipated for 1997, yielding estimated incidence and mortality rates of 364 and 87 per 100,000 women aged 60-69, respectively.

Formal screening programs

Whether a woman will get a mammogram depends to some extent on the availability and coordination of the service. In 1988, the Workshop on the Early Detection of Breast Cancer, which included representatives of the government and of volunteer and professional groups across the country, recommended biennial mammographic screening for women aged 50-69. The Workshop Report also recommended the establishment of dedicated screening centres.[1]

As a result of initiatives from the medical community and Health Canada, formal breast screening programs have been set up in all provinces except Quebec and Prince Edward Island, both of which are in the process of developing them. The first province to organize a program was British Columbia in 1988; Newfoundland, in 1996, was the latest to do so.

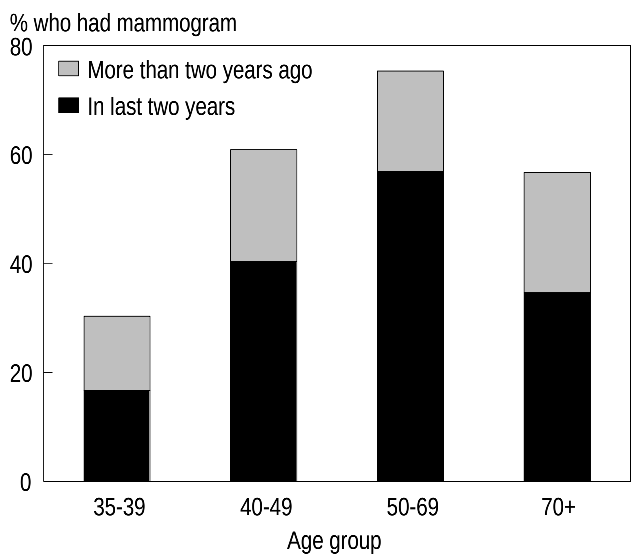
All formal provincial breast screening programs now target women in their fifties and sixties for biennial screening, British Columbia having dropped the 40-49 age group from its program in 1995 (see *When should breast screening start?*). The recommended upper age limit in all formal screening programs is now 69. Several provinces accept women older than 69 on request.[2,17]

High rates for targeted age group

In 1994/95, the lifetime mammography rate was highest—75% (1.9 million)—for women in the targeted age group, 50-69 (Chart 1). The rate for

Chart 1

Mammography rates, by age group, Canada, 1994/95



Data source: *National Population Health Survey, 1994/95* women aged 40-49 was 61%. Many of the latter group may have had diagnostic (as opposed to screening) mammograms because of a family history of breast cancer or to investigate breast problems. As well, some of them were targeted for screening, because in 1994/95, British Columbia was still recommending that women in their forties have mammograms.

At older ages, mammographic utilization falls. The lifetime rate for women aged 70 and over was 57%. These results are consistent with earlier studies.[5,6,11]

When should breast screening start?

Whether breast screening should begin at age 40 or 50 has been the subject of discussion.[18-27] In Canada, breast cancer incidence and mortality rates among women in their forties are low compared with rates for older women. Nonetheless, the numbers are still considerable. In 1997, an estimated 3,200 women aged 40-49 will be diagnosed with breast cancer, and 570 women in this age group will die of it.[16]

The debate about when women should start having regular mammograms has recently intensified with the release of new recommendations in the United States. In April 1997, the U.S. National Cancer Institute joined the American Cancer Society in recommending annual screening of women in their forties.[28]

Recommendations vary in other countries, although the focus is on women aged 50 and over.

In Canada, the National Breast Screening Study, which began in 1980, is following a cohort of 90,000 women, who were in their forties and fifties when they entered the study, to determine the efficacy of mammography in detecting early breast cancer, and ultimately, reducing mortality. Initial results have not shown decreased breast cancer mortality among women who were screened in their forties.[18]

According to the 1994/95 National Population Health Survey, 1.2 million women in their forties have had a mammogram. The rates were highest in Quebec (71%) and British Columbia (66%), the latter of which targeted 40-49-year-olds in its screening program until 1995.[2] Some of these women would have been referred for a diagnostic mammograms.

The Canadian Cancer Society recommends biennial screening for women aged 50-69. All formal provincial breast screening programs now target this age group.

Despite the high rate for 50-69-year-olds, 25% of them had never had a mammogram. Moreover, lifetime mammography rates tell only part of the story, as screening guidelines recommend a mammogram every second year for this age group. Around 24% of women in the targeted age range who had had a mammogram had not done so in the previous two years. Consequently, an estimated 1.1 million women aged 50-69 had either never had a mammogram or had had one, but not as recently as recommended.

Provincial rates and odds

Although screening programs account for a relatively small share of all mammograms (16% in 1994),[2] the two provinces with the longest-running programs—British Columbia and Saskatchewan—had the highest lifetime mammography rates for women aged 50-69 (Appendix, Table A). On the other hand, lifetime rates for this age group were low in Newfoundland, New Brunswick, and Manitoba.

Compared with Saskatchewan (which had the highest odds), the odds were significantly low that women aged 50-69 in Newfoundland, New Brunswick, and Manitoba would have ever had a mammogram (Table 1). Nonetheless, the NPHS was conducted before these three provinces had set up breast screening programs, so the effects of these programs would not be evident in 1994/95 mammography rates.

In Nova Scotia, where a formal breast screening program had been established in 1991, the odds were also low, compared with Saskatchewan, that women aged 50-69 would ever have had a mammogram (odds ratio .28) This is likely related to the fact that the program is still expanding and is not province-wide.

Table1
Odds ratios for mammogram utilization, women aged 50-69, 1994/95

Independent variable	Category	Ever had mammogram: Odds ratio	Ever had mammogram: 95% confidence interval	If ever had mammogram, had one in last two years: Odds ratio	If ever had mammogram, had one in last two years: 95% confidence interval
Marital status	Single (never married)†	1.00	...	1.00	...
	Now married	2.15**	1.4, 3.4	1.21	.66, 2.2
	Common-law/living with partner	2.07	.73, 5.9	.99	.30, 3.3
	Separated or divorced	1.41	.85, 2.3	.73	.38, 1.4
	Widowed	2.29**	1.4, 3.8	.78	.40, 1.5
Province of residence	Saskatchewan†	1.00	...	1.00	...
	British Columbia	.82	.40, 1.7	.84	.34, 2.0
	Alberta	.76	.36, 1.6	1.18	.44, 3.2
	Quebec	.74	.39, 1.4	.26**	.12, .59
	Ontario	.74	.38, 1.4	.48	.21, 1.1
	Prince Edward Island	.73	.12, 4.7	1.40	.10, 20.7
	New Brunswick	.41*	.18, .94	.55	.18, 1.7
	Manitoba	.40*	.18, .90	.23**	.09, .64
	Nova Scotia	.28**	.13, .63	.46	.16, 1.3
	Newfoundland	.23**	.09, .57	.39	.10, 1.5
Resides in census metropolitan area?	No†	1.00	...	1.00	...
	Yes	1.23	.97, 1.6	1.63**	1.2, 2.1
Education	Less than secondary†	1.00	...	1.00	...
	Secondary	1.53*	1.1, 2.1	.83	.57, 1.2
	Beyond high school	1.27	.95, 1.7	1.02	.72, 1.5
	College or university	2.15**	1.6, 2.9	1.16	.82, 1.7
Household income	Low†	1.00	...	1.00	...
	Lower middle	.74	.55, 1.0	.72	.49, 1.1
	Upper middle	1.00	.71, 1.4	.78	.52, 1.2
	High	.98	.62, 1.5	1.07	.63, 1.8
Main activity	Working†	1.00	...	1.00	...
	Working and caregiving	.72	.47, 1.1	.92	.56, 1.5
	Caregiving	.53**	.38, .75	.74	.50, 1.1
	Looking for work	.58	.24, 1.4	.20**	.07, .60
	Retired (includes at school and ill)	.56**	.40, .78	.77	.54, 1.1
Place of birth	Canada†	1.00	...	1.00	...
	Other North America, Europe, Australia,	.81	.59, 1.1	1.45	.97, 2.2
	South America, Central America, Caribbean, Africa	.33**	.19, .59	.27**	.13, .58
	Asia	.29**	.17, .49	3.39	.99, 11.6
Visited doctor in last 12 months?	No†	1.00	...	1.00	...
	Yes	3.08**	2.4, 4.0	3.43**	2.4, 4.9
Has cancer?	No†	1.00	...	1.00	...
	Yes	2.85**	1.4, 5.7	1.80	.90, 3.6
Number of observations		2,111	...	1,532	...

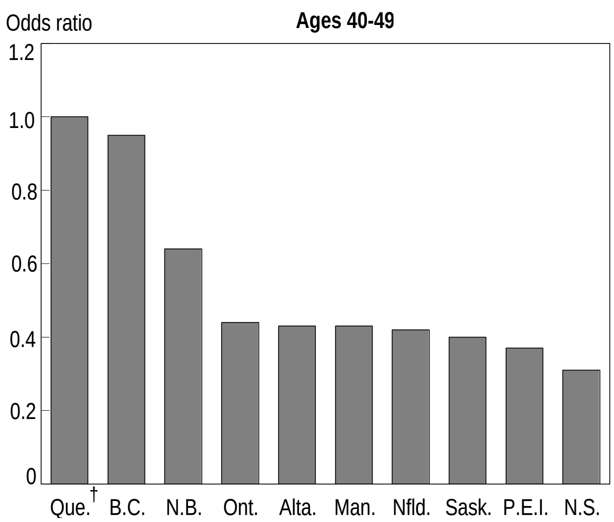
Data source: *National Population Health Survey, 1994/95*
Note: *Odds ratios are from two multivariate logistic regressions. Reference categories are the same for both regressions, and the reference categories do not always have the lowest or highest odds. The odds ratio for one category relative to another is equal to the ratio of their respective odds ratios. "Unknown" categories for the following variables were included in the model but are not shown here: resides in CMA, income, place of birth, and visited doctor in last 12 months.*
† Identifies reference category, for which odds ratio is always 1.00.
... Figures not appropriate or not applicable
$* 0.01<p \le 0.05$
$** p \le 0.01$

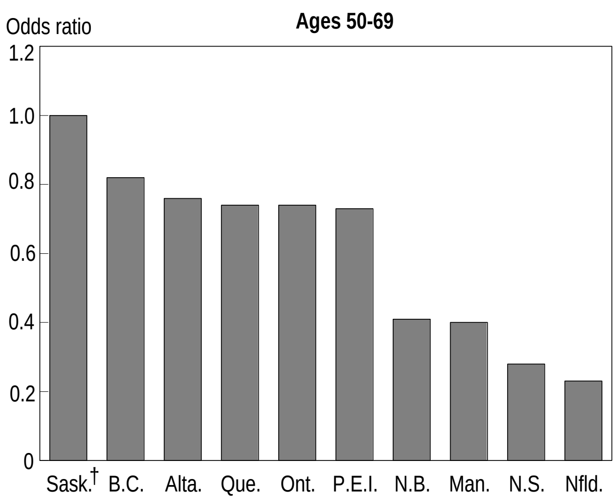
Targeting

Ideally, a province with a breast screening program that targets women in a specific age range would show relatively high odds for women of those ages ever having had a mammogram, and low odds for other ages. This was the case for Saskatchewan, which had the highest lifetime mammography odds for women aged 50-69 and the third-lowest odds for women aged 40-49 (Chart 2). British Columbia, which at the time of the NPHS was also targeting women in their forties, had high odds for both age groups.

On the other hand, Newfoundland had the lowest lifetime mammography odds for the targeted age group, and was in the mid-range for ages 40-49. Quebec had the highest lifetime odds for ages 40-49, and was in the mid-range for ages 50-69. New Brunswick was near the top (third-highest odds) for ages 40-49, but among the four lowest for ages 50-69. Nova Scotia's odds were low for both age groups.

Chart 2
Odds ratios for ever having had a mammogram, by age and province, 1994/95





Data source: *National Population Health Survey, 1994/95*
Note: *Odds ratios for ages 40-49 are from the same regression model as that in Table 1 for ages 50-69; the numerical values are not shown in this article.*
† Identifies reference category for which odds ratio is always 1.0.

Doctor's advice?

Doctors often advise women to have a mammogram, and in some cases, mammograms can only be obtained through physician referral. According to the NPHS, women who had not seen doctors recently were less likely to have had a mammogram than were those who had consulted a doctor in the past year. The odds of ever having had a mammogram differed significantly for these two groups by a factor of more than three (odds ratio 3.08). And at 15%, the percentage of women aged 50-69 who had not contacted a doctor in the previous year was noteworthy (Table 2).

Marital status

Compared with women who were married (including common-law and living with a partner) and formerly married (separated/divorced or widowed), those who were single had lower odds of ever having had a mammogram. However, at ages 50-69, only 6% of women were single.

Socioeconomic effects notable

A number of socioeconomic characteristics are related to the likelihood of having a mammogram.[6,8,11,12,29] Women aged 50-69 who were caregiving or retired[a] had significantly low odds of ever having had a mammogram,

[a] *This category also includes women who were ill or attending school.*

compared with women whose main activity was paid employment. Those who were caregiving or retired made up over 60% of all women aged 50-69.

Lifetime mammography odds tended to rise with educational attainment. The odds among women who had not graduated from high school differed from those of women with university or college completion by a highly significant factor of more than two (odds ratio 2.15). As well, about four out of ten women aged 50-69 had less than high school graduation.

Unlike main activity and education, household income alone had no significant effect on whether a woman would ever have had a mammogram.

Country of birth

Compared with Canadian-born women, the odds of having had a mammogram were significantly lower for women who had immigrated from Asia (odds ratio .29) or from South or Central America, the Caribbean, or Africa (odds ratio .33). These are areas where breast cancer rates are considerably lower than in Canada. Moreover, women from these parts of the world accounted for just 7% of all women aged 50-69.

Cancer diagnosis

As might be expected, being diagnosed with cancer was strongly associated with having had a mammogram. Women aged 50-69 who had cancer (of any form, not necessarily breast cancer) had almost three times the odds (odds ratio 2.85) of ever having had a mammogram as did women without cancer.[b] This variable adjusts the other results of the analysis for whether or not the women having mammograms had cancer. However, women with cancer made up only a small proportion (just over 4%) of all women aged 50-69.

Table 2
Percentage distributions† of characteristics, women aged 50-69, 1994/95

	%
Marital status	
Single (never married)	6.0
Now married	68.0
Common-law/living with partner	1.4
Separated or divorced	11.8
Widowed	12.8
Other	0.2
Province of residence	
Newfoundland	1.7
Prince Edward Island	0.4
Nova Scotia	3.3
New Brunswick	2.8
Quebec	27.8
Ontario	37.6
Manitoba	3.4
Saskatchewan	3.4
Alberta	7.4
British Columbia	12.4
Resides in census metropolitan area?	
No	39.5
Yes	60.2
Unknown	0.4
Education	
Less than secondary	38.5
Secondary	15.3
Beyond high school	20.7
College or university	25.5
Unknown	0.1
Household income	
Low	18.7
Lower middle	29.9
Upper middle	32.0
High	13.7
Unknown	5.8
Main activity	
Working	19.6
Working and caregiving	12.2
Caregiving	32.7
Looking for work	1.3
Retired (includes at school and ill)	34.2
Place of birth	
Canada	77.1
Other North America, Europe, Australia	15.6
South America, Central America, Caribbean, Africa	3.0
Asia	4.0
Unknown	0.4
Visited doctor in last 12 months?	
No	14.9
Yes	84.7
Unknown	0.3
Has cancer?	
Yes	4.3
No	95.7

Data source: *National Population Health Survey, 1994/95*
† Distributions weighted to represent 2,551,674 non-institutionalized women aged 50-69 in the 10 provinces. Excludes respondents with unknown mammogram histories.

[b] Women diagnosed with cancer five or more years earlier, but who had been told it was cured, were not counted among those with cancer.

Within the last two years

For women aged 50-69, compliance with Canadian breast screening guidelines involves not only getting a mammogram, but doing so at regular two-year intervals. Given that a woman has had a mammogram, several variables were significantly related to having had one in the two previous years.

Women in Prince Edward Island had the highest odds that those who had had a mammogram would have done so within the recommended period (odds ratio 1.40). Women in Alberta, Saskatchewan, and British Columbia ranked next. Those in Manitoba, Quebec and Newfoundland had the lowest odds.

Unlike earlier studies, [6,8,13,29] NPHS data did not indicate that urban residence was significantly associated with ever having had a mammogram. But given that a woman had done so, the odds of having one within the last two years were significantly high if she lived in a census metropolitan area (odds ratio 1.63).

Women who had consulted a doctor in the previous year had significantly high odds of ever having had a mammogram, and given that they had had one, of doing so within the recommended period (odds ratio 3.43).

While educational attainment and main activity were significantly associated with ever having had a mammogram, these variables were generally not significant predictors of doing so in the recommended period. The exception was the small group (just over 1% of women in this age range) who were looking for work. If a woman had had a mammogram, the odds that she would have had one in the previous two years were significantly low for those seeking employment (odds ratio .20).

Women from Asia had the lowest odds of ever having had a mammogram, but those who had done so had the highest odds of having had one within the past two years. By contrast, women from South and Central America, the Caribbean, and Africa had low odds not only of ever having had a mammogram, but also of having had one in the past two years. The pattern among Asian-born women may indicate a higher level of awareness of and compliance with screening guidelines among those who have had a mammogram.

Implications

Canadian guidelines recommend that women aged 50-69 get mammograms and that they get them at certain ages and with a certain frequency. But despite gains in recent years, a large number of Canadian women in the targeted age group do not get mammograms, or do not get them as often as recommended.

Earlier studies found that women who have never had a mammogram tended to be older, non-white, poorer, less educated, and to reside in rural areas. They have tended not to have been advised by a physician to get a mammogram and not to know that asymptomatic women should be screened.

In the United States, having health insurance is an important factor, [5,29] and socioeconomic disparities in breast screening rates have been noted there. However, one Ontario study also found that universal health care was not enough to overcome socioeconomic disparities in mammography utilization.[30]

NPHS data show several factors to be predictors of whether a woman in the 50-69 age group will get a mammogram. The odds of doing so were significantly low for women who were single, who had relatively little education, who were not in the paid workforce, who were not in recent contact with a physician, and who were immigrants from South or Central America, the Caribbean, Africa, and Asia.

Some groups with low lifetime mammography odds represented large shares of the 50-69-year-old female population: women with less than high school education or who were out of the labour force. And even women with high lifetime mammography odds had not necessarily been examined as recently as recommended.

Finally, although a variety of inter-related personal characteristics influence whether a woman will get a mammogram and the frequency with which she will do so, some provinces have had less success than others in reaching the targeted age group.

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Appendix

Table A
Mammography rates, women aged 50-69, 1994/95

	Ever had mammogram†	Had mammogram in last two years‡
	%	
Marital status		
Single (never married)	62.7	72.2
Now married	76.6	77.7
Common-law/living with partner	80.2	76.6
Separated or divorced	73.7	70.1
Widowed	74.9	70.5
Province of residence		
Saskatchewan	82.3	86.7
British Columbia	79.5	85.2
Alberta	79.0	89.4
Quebec	75.9	63.9
Ontario	76.2	78.2
Prince Edward Island	76.3	87.7
New Brunswick	64.8	75.6
Manitoba	67.4	63.7
Nova Scotia	57.6	74.3
Newfoundland	48.2	69.3
Resides in census metropolitan area?		
No	72.6	70.2
Yes	77.0	79.0
Education		
Less than secondary	68.4	71.4
Secondary	79.1	73.7
Beyond high school	75.8	77.4
College or university	83.1	80.7
Household income		
Low	71.2	72.8
Lower middle	69.7	70.0
Upper middle	80.1	75.6
High	83.2	84.1
Main activity		
Working	82.6	77.5
Working and caregiving	77.4	80.3
Caregiving	72.4	76.0
Looking for work	63.4	43.9
Retired (includes at school and ill)	73.6	73.4
Place of birth		
Canada	76.6	73.8
Other North America, Europe, Australia	76.1	83.7
South America, Central America, Caribbean, Africa	55.4	54.4
Asia	64.2	94.4
Visited doctor in last 12 months?		
No	56.0	50.3
Yes	78.8	78.8
Has cancer?		
No	74.6	75.1
Yes	89.2	86.0

Data source: *National Population Health Survey, 1994/95*
Note: *Univariate rates weighted to represent 2,551,674 non-institutionalized women aged 50-69 and 1,920,239 women aged 50-69, who ever had a mammogram. Excludes unknown categories and respondents with unknown mammogram histories.*
† As a percent of women aged 50-69 in the 10 provinces
‡ As a percent of women aged 50-69 in the 10 provinces, who had ever had a mammogram

Reports

This section presents descriptive articles in the fields of health and vital statistics.

Update on breast cancer mortality, 1995

Leslie A. Gaudette, Ru-Nie Gao, Marek Wysocki and François Nault

Abstract

Objectives
This article updates recently published information on Canadian breast cancer mortality, highlighting a lower rate in 1995, a marked decline in the rate since 1990, and possible factors contributing to this trend.

Data source
Breast cancer mortality data are from the Canadian Vital Statistics Data Base, maintained by Statistics Canada.

Analytical tehniques
Age-standardized breast cancer mortality rates were calculated. The average annual percent change in mortality rates by age group and province was calculated and tested for statistical significance.

Main result
The age-standardized breast cancer mortality rate declined in 1995, continuing a downward trend that had begun in 1986. The 1995 rate is the lowest since 1950.

Key words
breast neoplasms

Authors
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Breast cancer is one of the most serious health concerns of Canadian women. It is the leading form of cancer in women (excluding non-melanoma skin cancer), accounting for about 30% of all new cases. It can occur at a relatively early age, when many other forms of cancer are far less likely to develop. In 1993, breast cancer was the leading cause of death in women aged 35-49.[1]

Recent Canadian data confirm a promising trend. The breast cancer mortality rate is falling. Using data from the Canadian Vital Statistics Data Base, this article updates breast cancer mortality information presented in the Autumn 1996 issue of *Health Reports* and discusses potential factors contributing to this downturn (see *Methods*).[1]

Mortality trends

In 1986, the age-standardized breast cancer mortality rate peaked at 31.9 deaths per 100,000 female population (Chart 1). The following year, it declined slightly and then stayed reasonably steady for the next three years. In 1991, the rate began to drop. At 28.4 deaths per 100,000 females, the 1995 breast cancer mortality rate is the lowest reported in the period since 1950.

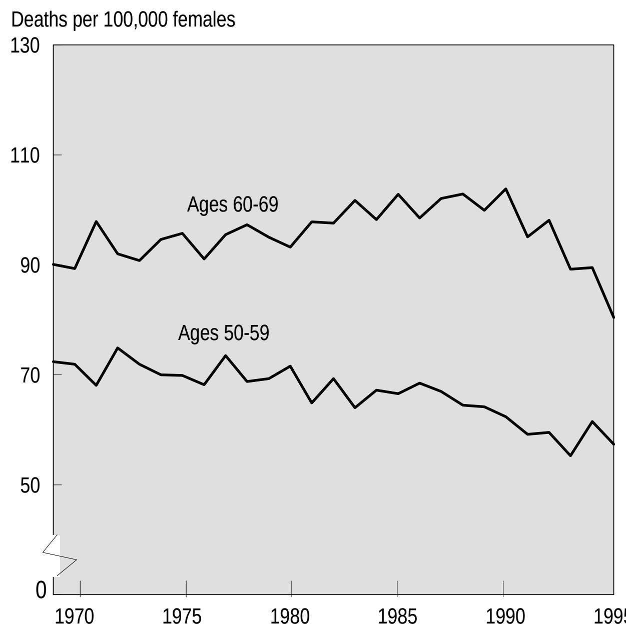
Statistically significant decreases in breast cancer mortality rates have occurred in all age groups under 70, including women in the age group (50-69) targeted for mammographic screening (Chart 2). The average annual percent decline in the rate since 1986 was about 2% for women in their fifties (Chart 3). For women in their sixties, the downturn began later, with rates declining by over 4% annually between 1990 and 1995.

Since 1986, the average annual percent change (AAPC) in the breast cancer mortality rate has been between -1% and -2% in all provinces except Newfoundland. The provinces with the largest declines since 1990—British Columbia (AAPC = -3.1%) and Saskatchewan (-3.4%)—have also achieved the highest rates of mammography through organized screening programs. The introduction of systemic adjuvant chemotherapy around 1980 and the consistent application of

Chart 1
Age-standardized female breast cancer mortality rate, Canada, 1969 to 1995

Data source: *Canadian Vital Statistics Data Base*
Note: *Age-standardized to the 1991 Canadian population*

Chart 2
Female breast cancer mortality rates, selected age groups, Canada, 1969 to 1995



Data source: *Canadian Vital Statistics Data Base*

Methods

Data source

This analysis is based on mortality data from the Canadian Vital Statistics Data Base. The data were provided to Statistics Canada by provincial/territorial vital statistics registries.

Analytical techniques

Rates in this article were age-standardized to the 1991 Canadian female population. Changes over time in annual age-standardized breast cancer mortality rates were examined by calculating the average annual percent change (AAPC). The AAPC is equal to $(e^{\beta}-1)100$, where β is the slope from a regression of the natural logarithm of rates on year.

treatment guidelines in British Columbia may also be contributing to improvements in survival.[2,3]

Increased mammographic screening

In 1985, 250,000 mammograms were performed in Canada.[4] By 1994, the number had climbed to 1.4 million. This was largely because of an increase in mammograms performed for screening rather than diagnostic purposes.

Current guidelines in Canada recommend biennial mammographic screening for women aged 50-69. By 1994, annual rates for women aged 50-69 in the five provinces with organized screening programs were approaching 30% or more. This may indicate that the desired goal for screening—70% of women aged 50-69 receiving a mammogram every two years—was close to being achieved in those provinces. However, Saskatchewan and British Columbia were the only provinces where the majority of mammograms were performed through organized screening programs (See *Who doesn't get a mammogram* in this issue).

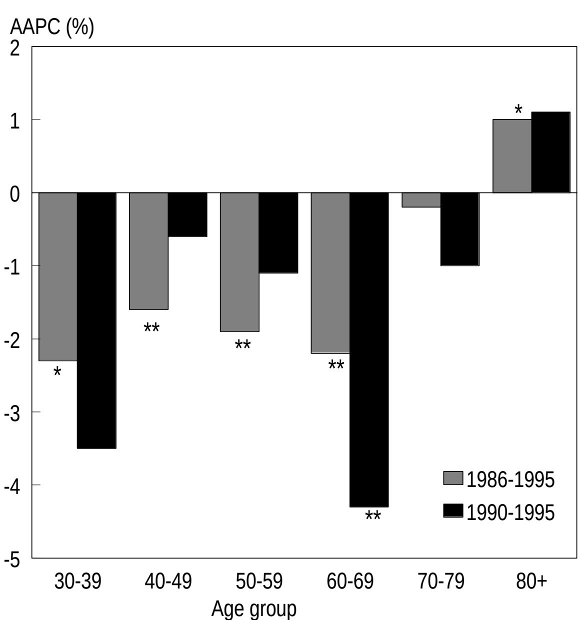
Because the decline in the breast cancer mortality rate occurred so soon after the increase in screening mammography, it is unlikely that screening alone is behind the decline. On the other hand, the earlier diagnoses achieved with mammography may be playing a role in combination with treatment advances and fertility patterns. Previous studies have indicated that both screening and treatment advances are affecting incidence and survival rates.[3,5] Decreases in the late 1980s in the diagnosis of regional disease (breast cancer that has spread to lymph nodes adjacent to the breast) among American women aged 40 and over were attributed to the increased use of mammography.[5] However, the steep drop in breast cancer mortality in the United States was thought to have occurred too rapidly to be explained by mammography alone.

Although mammographic screening was introduced between 1988 and 1992 in England and Wales, the decline in the mortality rate there was also seen as occurring too early to be due to screening.[6,7] Treatment advances, notably the widespread use of tamoxifen, were thought to be the most likely explanation for the decline in breast cancer mortality among women aged 50 and over.

In Canada, the United States, England and Wales, changes in fertility may also be influencing breast cancer mortality rates, particularly among the mothers of the baby-boom generation.[7,8] Declining breast cancer mortality rates for women born between 1924 and 1938 may reflect higher fertility rates after World War II. Dietary restrictions early in life during the Great Depression of the 1930s may also be affecting mortality in these cohorts in both North America and the U.K. Continued monitoring and analysis of trends in breast cancer mortality will be needed to assess the relative effect of mammography, treatment and various risk factors.

Chart 3

Average annual percent change (AAPC) in female breast cancer mortality rates, by age group, Canada, 1986 to 1995, and 1990 to 1995



Data source: *Canadian Vital Statistics Data Base*
** Significantly different from zero (p<0.05)*
*** Significantly different from zero (p<0.01)*

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Narrowing mortality gaps, 1978 to 1995

François Nault

Abstract

Objectives

This article examines the narrowing difference in life expectancy between men and women and among Canadian provincial populations in the context of trends in several major causes of death and risk factors.

Data sources

Canadian Vital Statistics Data Base; 1994/95 National Population Health Survey; 1985 and 1990 General Social Surveys; 1985 and 1990 Health Promotion Surveys; Canadian Provincial Heart Health Surveys, 1986 to 1992.

Analytical techniques

Age-standardized mortality rates were calculated by the direct method, using the adjusted 1991 population of Canada as the standard. Life expectancies at birth were calculated using 1995 deaths.

Main results

Narrowing differences in life expectancy between men and women since 1978 and among provincial populations have coincided with similar trends in several cause-specific age-standardized death rates and a number of behavioural risk factors.

Key words

life expectancy, risk factors, cause of death

Principal release

This article draws upon information from *Births and Deaths, 1995* (Statistics Canada, Catalogue 84-210-XPB). See *How to Order* on page 55.

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Mortality differences between men and women stem from biological, social, and behavioural conditions and from the complex interactions among these conditions.[1,2]

In most animal species, females tend to outlive males. In human beings, lower female mortality is evident at all ages, even among stillbirths and infants. And with the exception of societies where women's situation is extremely poor relative to that of men, lower female mortality is virtually universal and has prevailed as far back as mortality can be estimated.

Social and behavioural factors have reinforced the female biological advantage. Traditionally, men have had more dangerous occupations. They have tended to smoke and drink more than women, and have engaged in riskier activities. In addition, as indicated by the frequency of consultations with physicians, women are generally more vigilant about taking care of their health.[3]

Methods

Data sources

The data on leading causes of death are from *Births and Deaths 1995* (Catalogue 84-210-XPB), which provides the age-standardized death rates for the 31 leading causes of death by sex at the Canada level from 1979, and by province for both sexes combined for 1994 and 1995.[4] The data are from information collected by the provincial and territorial registries of vital statistics, which are responsible for the registration of deaths that occur in their jurisdictions. All causes contributing to a death are entered on the death certificate. In accordance with rules established by the World Health Organization and defined in the Ninth Revision of the International Classification of Diseases (ICD-9), a single, underlying cause of death is selected for each decedent.[5] The ICD-9 codes for the causes examined in this article are:

Cardiovascular diseases	390-459
Heart diseases	390-398, 402, 404, 410-429
Accidents and adverse effects	E800-E949
Motor vehicle accidents	E810-E825
Cancer	140-208
Lung cancer	162
Chronic obstructive pulmonary diseases	490-496

Data on risk factors are from the 1985 and 1991 General Social Surveys, the 1985 and 1990 Health Promotion Surveys, Canadian Provincial Heart Health Surveys conducted from 1986 to 1992, and the 1994/95 National Population Health Survey.

Analytical techniques

Death rates were calculated based on postcensal revised population estimates, which take into account net census undercoverage and include non-permanent residents. Age-standardized death rates were calculated by the direct method, using the age distribution of the 1991 population of Canada as the standard.

Life expectancy at birth is the average number of years a person is likely to live based on the prevailing age-sex-specific death rates. Life expectancy at birth was calculated using 1995 deaths only and the postcensal revised population estimates.

Body mass index (BMI) is calculated for people aged 20 to 64 and is defined as weight in kilograms divided by the square of height in metres. A BMI greater than 27 indicates that the person is overweight.

Limitations

This analysis compares trends in death rates with those for only a small number of risk factors. Other factors that were not considered may have influenced the outcomes. As a result, the connection between risk factors and mortality noted here is very broad.

It is difficult to establish time trends in the prevalence of even this limited number of risk factors, because the data are from different sources, and methods of collecting and measuring them have varied from survey to survey. More precise correlations would require a much more thorough examination of the surveys, and where possible, recompilation of the data using standard concepts.

As well, any conclusions about individual risk must be made cautiously, if at all, as data on individual behaviour that might influence risks were not collected. Moreover, because the data are from different sources, they do not pertain to the same individuals.

Finally, the life expectancy gap was widest in 1978, but in this analysis, cause-specific 1995 death rates are compared with 1979, the first year that ICD-9 codes were in place. The use of 1978 data would have necessitated recoding to make the categories of causes comparable to 1995.

In Canada from 1921 to 1978, while the life expectancy of both sexes increased, women made faster gains than men. As a result, the gap in life expectancy at birth widened steadily in women's favour from 1.8 to 7.5 years.[6] Greater life expectancy gains for men than for women since then reduced the gap to 5.9 years by 1995: 75.4 versus 81.3 years (Table 1).[4] Thus, the longevity advantage that Canadian women have enjoyed over men is diminishing (Chart 1).

This convergence of male and female life expectancy reflects trends in several major causes of death and in a number of risk factors that have benefited men more than women. The narrowing life expectancy gap between the sexes is not unique to Canada: it is a feature of the industrialized world.[7,8]

Life expectancy differences among the provinces have also been reduced, although an upward east-to-west gradient persists, in part, because of differences in the prevalence of risk factors.

With information from the Canadian Vital Statistics Data Base and a number of health surveys conducted by Statistics Canada and other agencies, this article discusses differences in life expectancy at birth by sex and by province in the context of trends in several leading causes of death and risk factors (see *Methods*).

Causes of death

Trends in several leading causes of death have played a part in the diminishing difference between male and female life expectancy.[9] For example, the age-standardized death rate for cardiovascular diseases, notably diseases of the heart, decreased among both sexes, but the absolute decline was faster among men than among women. Over the 1979 to 1995 period, the difference between the sexes in the death rate for cardiovascular diseases narrowed by 92 deaths per 100,000 population (Table 2). The gap narrowed for chronic obstructive pulmonary diseases, too, but this was attributable to a sharp

Table 1

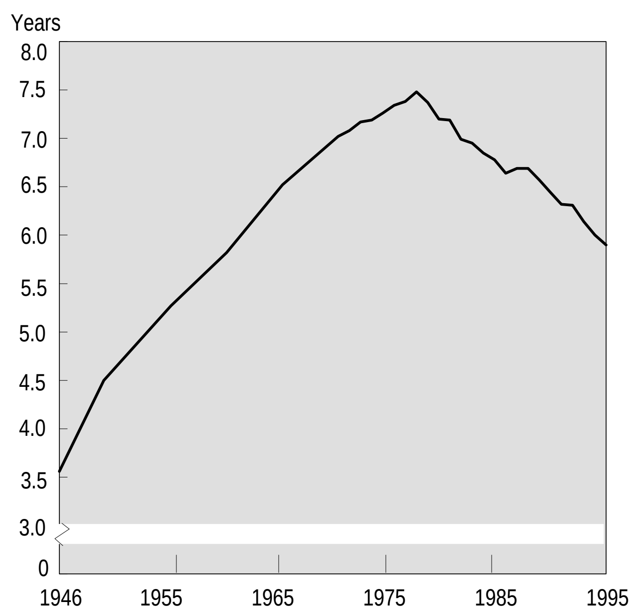
Life expectancy at birth,† by sex, Canada, provinces and territories, 1995

	Both sexes	Male	Female	Difference
	Years			
Canada	**78.3**	**75.4**	**81.3**	**5.9**
Nfld.	77.3	74.4	80.6	6.2
P.E.I.	77.7	74.1	81.5	7.4
N.S.	77.9	74.9	80.8	5.9
N.B.	77.8	74.2	81.5	7.3
Que.	78.0	74.6	81.3	6.7
Ont.	78.5	75.8	81.2	5.4
Man.	77.7	74.8	80.5	5.7
Sask.	78.2	74.9	81.6	6.7
Alta.	78.6	75.8	81.5	5.7
B.C.	79.0	76.2	81.9	5.7
Yukon	72.4	69.5	76.5	7.0
N.W.T.	74.3	72.8	76.0	3.2

Source: *Statistics Canada (reference 4)*
† Based on one year of mortality data

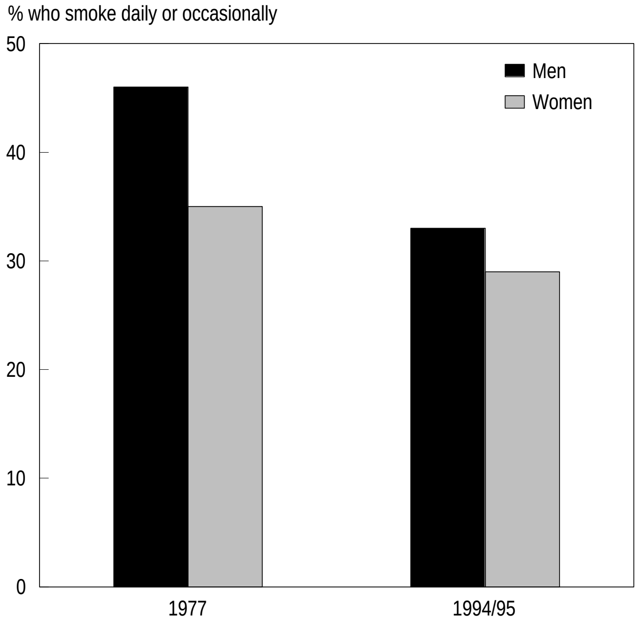
Chart 1

Gap in life expectancy at birth between males and females, Canada, 1946 to 1995



Data source: *Canadian Vital Statistics Data Base*
Note: *Annual data from 1971 to 1995; earlier data presented at five-year intervals*

Chart 2
Age-standardized smoking rates, population aged 20 and over, by sex, Canada, 1977 and 1994/95



Source: *Millar WJ (reference 12)*

increase in women's death rate. And while the sex difference in overall cancer mortality did not diminish substantially, the exception was lung cancer, where the gap narrowed because of a steep rise in women's death rate. Lung cancer is now the leading cause of cancer death among women.[10]

Declines in mortality due to accidents and adverse effects were also greater for men than for women. As well, fatality rates in several male-dominated industries such as mining, construction, and transportation and storage have fallen since the mid-1970s.[11]

Sex differences in risk factors reduced

A variety of risks factors may be involved in any specific cause of death. While links with some of these factors are well-established, definitive connections with others have yet to be proven. Moreover, relationships between risk factors and mortality are complex and may involve a time-lag, so current mortality differences may reflect the prevalence of risk factors in the more or less distant past rather than the present situation. Nonetheless, trends in smoking and being overweight, risk factors for some leading causes of death, have mirrored the narrowing gap in male and female life expectancy.

Table 2
Death rates, selected causes, by sex, Canada, 1979 and 1995

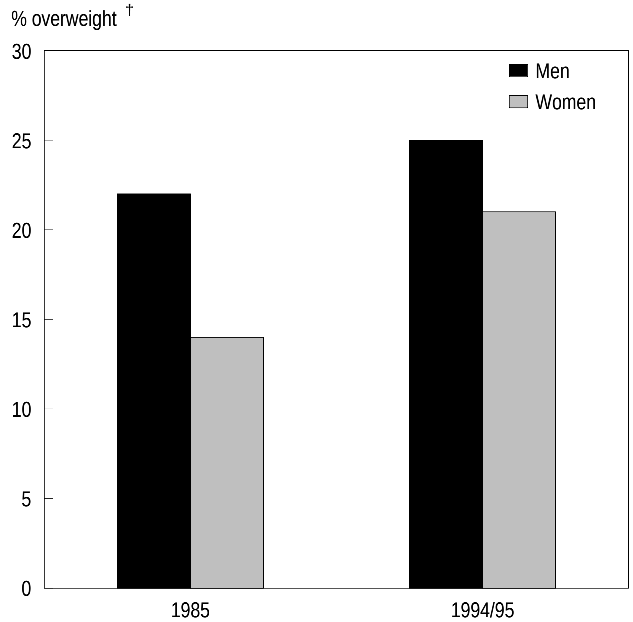
Causes	1979 Male	1979 Female	1979 Difference	1995 Male	1995 Female	1995 Difference	Change in difference 1979 to 1995
	Deaths per 100,000 population						
Cardiovascular diseases	526.4	311.7	214.7	316.9	193.8	123.1	91.6
Diseases of the heart	394.7	212.0	182.7	238.7	134.8	103.9	78.8
Cancer	239.0	150.2	88.8	234.7	150.3	84.4	4.4
Lung cancer	71.6	16.3	55.3	72.1	31.1	41.0	14.3
Accidents and adverse effects	73.3	29.0	44.3	39.9	18.5	21.4	22.9
Motor vehicle accidents	33.8	12.7	21.1	15.5	6.7	8.8	12.3
Chronic obstructive pulmonary diseases	43.1	10.4	32.7	44.7	19.3	25.4	7.3

Source: *Statistics Canada (reference 4)*
Note: *Age-standardized to the 1991 Canadian population*

Smoking is a major risk factor for cardiovascular diseases, lung cancer and chronic obstructive pulmonary diseases—all causes of death in which the difference in death rates between the sexes diminished since 1979. Over roughly the same period, the smoking rates of adult men and women (aged 20 and over) tended to converge.[12] From 1977 to 1994/95, the age-standardized smoking rate fell from 46% to 33% for men and from 35% to 29% for women (Chart 2). The sex difference in smoking rates, therefore, shrank from 11 to 4 percentage points.

Data based on self-reported weight and height from Statistics Canada's 1985 General Social Survey and from the 1994/95 National Population Health Survey (NPHS) show that over this ten-year period, the percentage of people aged 20-64 who were overweight increased for both sexes, but more for women than for men.[3,13] In 1985, 22% of men and 14% of women were overweight (body mass index over 27), a difference of 8 percentage points. By 1995, 25% of men and 21% of women were overweight, a difference of 4 percentage points (Chart 3).

Chart 3
Percentage of adult population who are overweight, Canada, 1985 and 1994/95



Data source: *Statistics Canada (reference 13) and 1994/95 National Population Health Survey*
† Population aged 20-64 with body mass index > 27

Provincial life expectancy differences less pronounced

Historically, life expectancy has been lower in eastern Canada (Quebec and the Atlantic provinces), but once-wide provincial differences have diminished.[3]

From 1926 to 1976, Saskatchewan residents generally had the longest life expectancy, and Quebec residents, the shortest.[a] This provincial difference, however, fell from 9.3 years in 1926 to 1.8 years in 1976. Thereafter, the gap narrowed only slightly. By 1995, life expectancy at birth ranged from 77.3 years in Newfoundland to 79.0 years in British Columbia, a difference of 1.7 years.

The shrinking provincial life expectancy gaps were accompanied by changes in rankings. In 1995, Alberta and Ontario had the second and third longest life expectancies at birth. Saskatchewan ranked fourth, but for the first time, was below the national average. And although Manitoba's life expectancy also used to be above the national average, it is now slightly below those of Quebec, Nova Scotia and New Brunswick.

Estimates of life expectancy for the Yukon and the Northwest Territories are somewhat less reliable because of their small populations. Nonetheless, life expectancy in the territories is estimated to be below the Canadian average by three to six years.

Provincial risk factors

To some extent, the introduction of universal health care insurance contributed to the

[a] Prince Edward Island ranked first in 1926, 1946 and 1951, but because of the small population, life expectancy estimates for the province are less reliable than for other provinces.

Table 3
Death rates, selected causes, Canada and provinces, 1995

	Cardio-vascular diseases	Dis-eases of the heart	Cancer	Lung cancer	Chronic obstructive pulmonary diseases
	Deaths per 100,000 population				
Canada	**247.1**	**179.9**	**184.9**	**48.6**	**28.8**
Nfld.	311.2	227.4	192.8	49.6	28.8
P.E.I.	281.3	211.5	199.2	62.5	28.7
N.S.	266.2	197.6	205.5	58.2	30.8
N.B.	264.1	193.7	199.9	54.3	31.7
Que.	245.9	184.3	198.2	57.5	34.8
Ont.	248.4	178.9	182.4	44.4	26.3
Man.	271.1	198.2	189.8	49.0	24.5
Sask.	241.3	176.2	172.6	45.1	24.4
Alta.	243.8	174.8	172.8	44.0	27.7
B.C.	223.0	157.6	167.8	43.1	27.3

Source: *Statistics Canada (reference 4)*
Note: *Age-standardized to the 1991 Canadian population*

Table 4
Percentage of population aged 18-74 with major risk factors for cardiovascular diseases, by province, Canada, 1986-1992

	At least one major risk factor	Regular smoking†	High blood pressure‡	Elevated blood cholesterol§
	%			
All provinces	**63**	**27**	**15**	**43**
Nfld.	69	35	22	43
P.E.I.	65	29	20	45
N.S.	69	33	19	44
N.B.	67	31	19	46
Que.	67	32	13	48
Ont.	61	23	17	40
Man.	62	25	16	44
Sask.	61	24	16	43
Alta.	58	27	15	37
B.C.	59	25	13	43

Source: *Health Canada (reference 14)*
Note: *Age-sex-standardized to the 1986 Canadian population*
† One or more cigarettes per day
‡ Diastolic pressure ≥90mm Hg or being treated with medication, salt-restricted diet or weight-reduction program
§ Total plasma cholesterol level ≥5.2 mmol/L

reduction in provincial life expectancy differences. Those differences that persist are reflected in cause-specific death rates and in the prevalence of several risk factors.

In 1995, age-standardized death rates for cardiovascular diseases, cancer (particularly lung cancer), and chronic obstructive pulmonary diseases were generally lower west of Quebec (Table 3). This is not surprising, as a number of risk factors displayed the same geographic pattern.

Canadian Provincial Heart Health Surveys from 1986 to 1992 measured the prevalence of the major risk factors for cardiovascular diseases—smoking, high blood pressure, and elevated blood cholesterol.[14] Close to two-thirds (63%) of Canadian adults had at least one of these risk factors, with the highest percentages in Newfoundland and Nova Scotia, and the lowest in Alberta and British Columbia. Smoking rates were highest in the Atlantic provinces and Quebec (Table 4).

However, other variables not considered in the Heart Health Surveys may have played a role in reducing the provincial life expectancy gaps. For example, because mortality tends to be lower in metropolitan than in rural areas, life expectancy may be longer in more urbanized provinces. In addition, since mortality differences also exist by marital status, level of education and income, provinces with larger percentages of married, highly educated and/or affluent residents might also enjoy an advantage.[15]

Concluding remarks

It would appear that while both men and women are living longer, the widest life expectancy gap between them was reached in the late 1970s. Diminishing differences in the prevalence of some risk factors suggest that the gap will continue to narrow. As well, the east-to-west gradient in provincial mortality could be changing. Increasingly, differences in provincial life expectancies may depend on the socioeconomic characteristics of each province's population.

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Monthly and daily patterns of death

Richard Trudeau

Abstract

Objectives
Using Canadian mortality data from 1974 to 1995, this article examines seasonal and daily patterns of death by cause.

Data source
Death records were extracted from the Canadian Vital Statistics Data Base, which is compiled from information provided to Statistics Canada by the Vital Statistics Registries in each province and territory.

Analytical techniques
Components of the time series of deaths by cause were calculated using X-11-ARIMA, developed by Statistics Canada. It combines the X-11 seasonal adjustment method of the U.S. Bureau of the Census and the ARIMA forecasting method.

Main results
For at least the past two decades, the highest number of deaths have occurred in the winter months. By specific cause, notable exceptions were deaths attributable to motor vehicle accidents and suicide. On a weekly basis, Saturday saw the largest numbers of deaths.

Key words
seasonality, cause of death, pneumonia, influenza, cardiovascular diseases, motor vehicle accidents, suicide

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While death may happen at any time as a result of illness or accident, to some extent, its timing is predictable. Most obviously, death is likely to occur at older ages. But there is another less obvious element of predictability in the timing of death. Some seasons of the year bring more deaths than do others, and deaths attributable to a number of specific causes tend to follow a yearly cycle.

These seasonal fluctuations are more than a curiosity. Because seasonal upsurges of deaths from specific causes are predictable, preventive health and safety measures may be able to reduce the toll.

This article uses mortality statistics from the Canadian Vital Statistics Data Base to examine how the number of deaths varies by month and by day (see *Methods*).

Methods

Data source

The 1995 figures in this article are taken from *Births and Deaths, 1995* (Catalogue 84-210-XPB).[1] Data on deaths from 1974 to 1994 are from the Canadian Vital Statistics Data Base. The data are adapted from information collected by the provincial and territorial registries of vital statistics, which are responsible for the registration of deaths that occur in their jurisdictions. All causes contributing to a death are entered on the death certificate. In accordance with rules established by the World Health Organization and defined in the Ninth Revision of the International Classification of Diseases (ICD-9), a single, underlying cause of death is selected for each decedent.[2] The ICD-9 codes for the causes of death examined in detail in this article are:

All causes	001-E999
Cardiovascular diseases	390-459
Pneumonia and influenza	480-487
Motor vehicle accidents	E810-E825
Suicide	E950-E959

Population estimates adjusted for net census undercoverage and for non-permanent residents are used to calculate all rates. The reference date for the annual population estimates is July 1.

Analytical techniques

The analysis is based on the average number of deaths per day for each month from 1974 to 1994. The average number of deaths per day is used to adjust for differing numbers of days per month.

The method used to calculate the components of the time series of deaths by cause is X-11-ARIMA, developed by Statistics Canada, which combines the X-11 seasonal adjustment method of the U.S. Bureau of the Census and the ARIMA (Auto-Regressive Integrated Moving Average) forecasting method.[3,4]

In this article, the seasonal component of the time series is expressed as a percentage, and it varies around 100%. For example, a seasonal factor of 110% for a certain month means that the average number of deaths per day is 10% higher in that month than if there were no seasonality in the series. Statistics about the seasonal pattern are the peak (the value of the highest seasonal factor), the trough (the value of the lowest seasonal factor), and the amplitude (the difference between the peak and trough).

The X-11-ARIMA Seasonal Adjustment Program in SAS was used to calculate the multiplicative seasonal adjustment, using the automatic selection process in which the best model from a set of five predefined ARIMA models is used. When processing the time series of average number of deaths per day by month due to all causes with the X-11-ARIMA procedure in SAS, all ARIMA models failed. Therefore, the ARIMA processing was skipped. The X-11 procedure did discern a stable seasonality.

The same X-11-ARIMA procedure in SAS was run for various time series of average number of deaths per day by month due to specific causes. A statistically significant stable seasonality was observed for certain causes, but not for others.

Deaths by day of the week were also analysed. Using deaths that occurred from 1974 to 1994 for which the complete date was available, the hypothesis that the number of deaths was evenly distributed across the seven days of the week was tested.

Limitations

Because of legal reporting requirements, the registration of deaths is considered to be virtually complete. However, records received after the "cut-off" date for data release are missing, as are deaths of Canadians in foreign countries other than the United States. Deaths of non-permanent residents may be excluded if the usual place of residence of the deceased was not Canada.

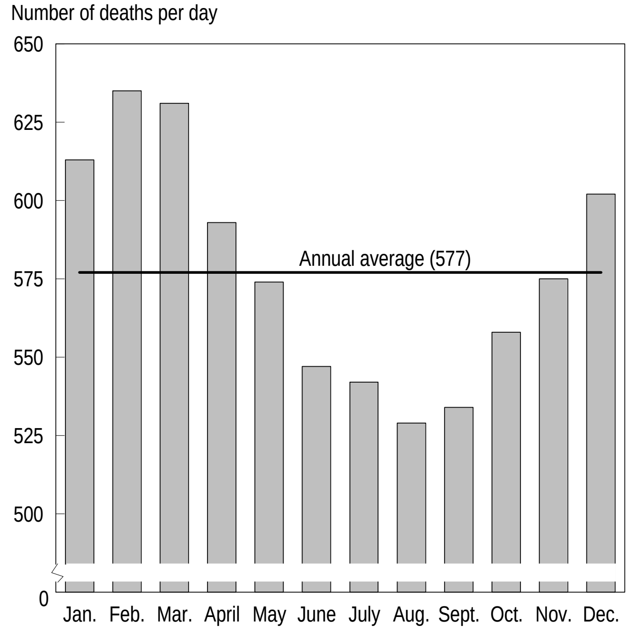
Hard winters

In 1995, there were 210,733 deaths in Canada, an average of 17,561 per month and 577 per day. However, more deaths occurred in some months than in others. December, January, February and March saw above-average numbers of deaths. The numbers from June through October were well below the monthly average. Adjusting for the number of days in each month, the average daily number of deaths peaked in February at 635 and fell to a low of 529 in August (Chart 1).

The winter upturn in deaths has prevailed for at least the past two decades. From 1974 to 1994, the seasonal peaks were in January. These peaks were as high as 10% above the average daily number of deaths that would have occurred had there been no seasonality in the series. Seasonal troughs were around 6% below average and occurred in August, yielding a seasonal amplitude of approximately 16% (Chart 2).

Chart 1

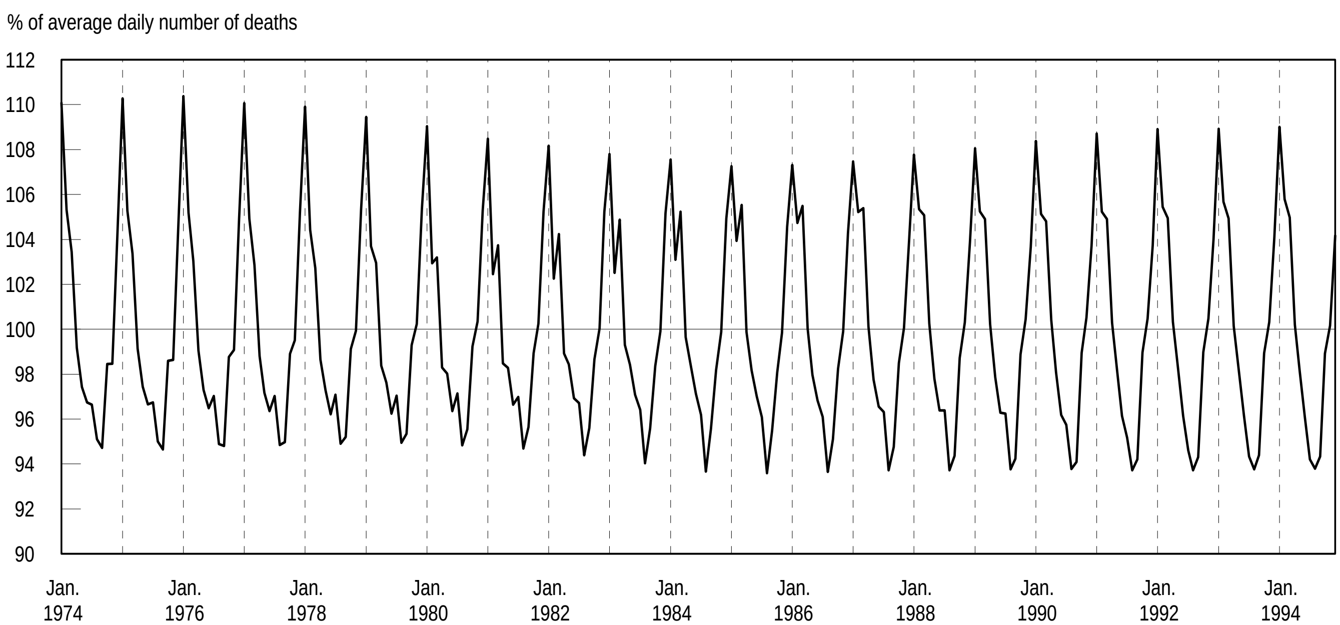
Average daily number of deaths, by month, Canada, 1995



Data source: *Canadian Vital Statistics Data Base*

Chart 2

Seasonality of deaths, Canada, January 1974 to December 1994



Data source: *Canadian Vital Statistics Data Base*

Such seasonal patterns in deaths have long been observed.[5-7] They have been related to variations in temperature and humidity that affect the environment, and in turn, have a physiological effect on humans. But normal temperature variations account for only a small part of the seasonal mortality pattern.[8]

Seasonal fluctuations in human activities may result in different levels of exposure to sources of infection. For example, during the winter, more time spent indoors in close proximity to other people may facilitate the transmission of viruses.

And some noninfectious causes of death, such as drownings or skiing accidents, have an obvious seasonal component. On the other hand, seasonal variations in deaths due to causes such as cardiovascular diseases are less readily explained.

Pneumonia and influenza

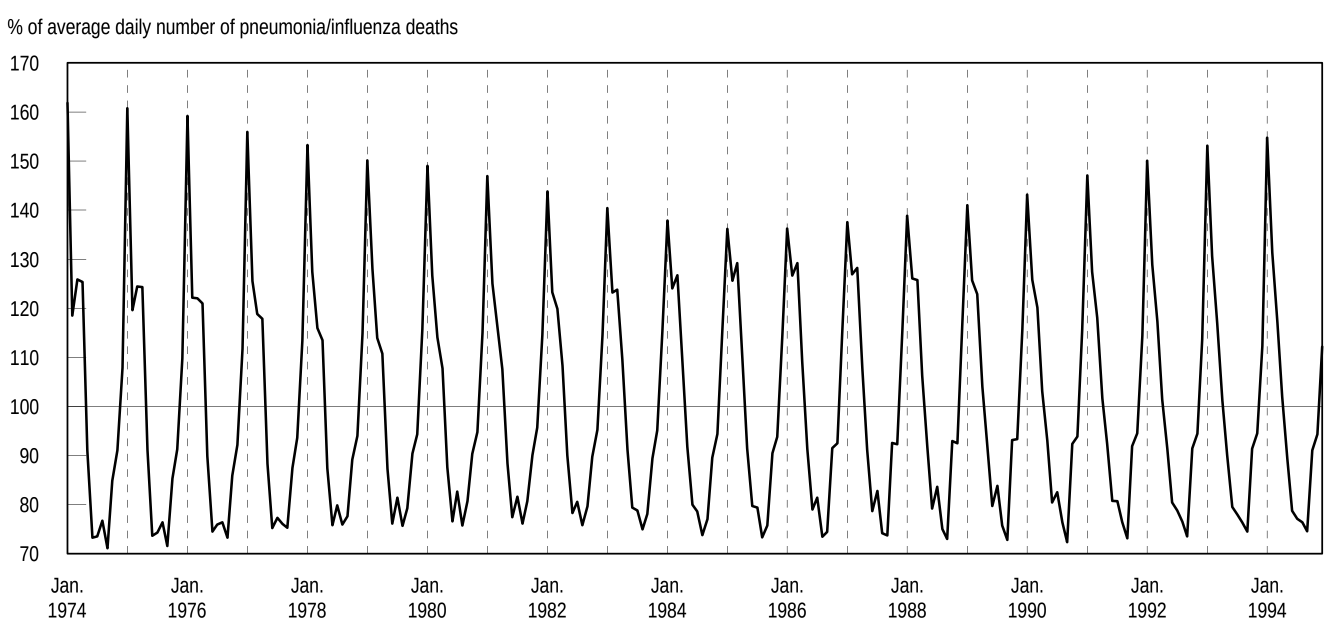
Deaths from pneumonia and influenza are highly seasonal, paralleling the elevated incidence and prevalence of these diseases in the winter months.[9] (This is also true for deaths from bronchitis, emphysema, and asthma.) Pneumonia and influenza accounted for just 3.2% of deaths over the entire 1974 to 1994 period, but the percentage was lower in the summer months and generally much higher in the winter. Throughout the period, the average daily number of pneumonia and influenza deaths peaked in January, and bottomed out in August or September

Despite some narrowing, the seasonal amplitude for these deaths was much greater than that for deaths from other major causes. The seasonal peaks for pneumonia and influenza deaths declined from 62% above the average daily number in 1974 to 36% above average in the mid-eighties, and then rose to 55% above it in 1994. The seasonal troughs varied only slightly from 29% below average in 1974 to 24% below average in the early eighties (Chart 3).

Cardiovascular diseases

Deaths directly attributable to pneumonia and influenza represent only a small share of the winter increase in deaths. In fact, over half of total excess mortality during influenza epidemics

Chart 3
Seasonality of pneumonia and influenza deaths, Canada, January 1974 to December 1994



Data source: *Canadian Vital Statistics Data Base*

has usually been ascribed to other causes, notably cardiovascular diseases.[10]

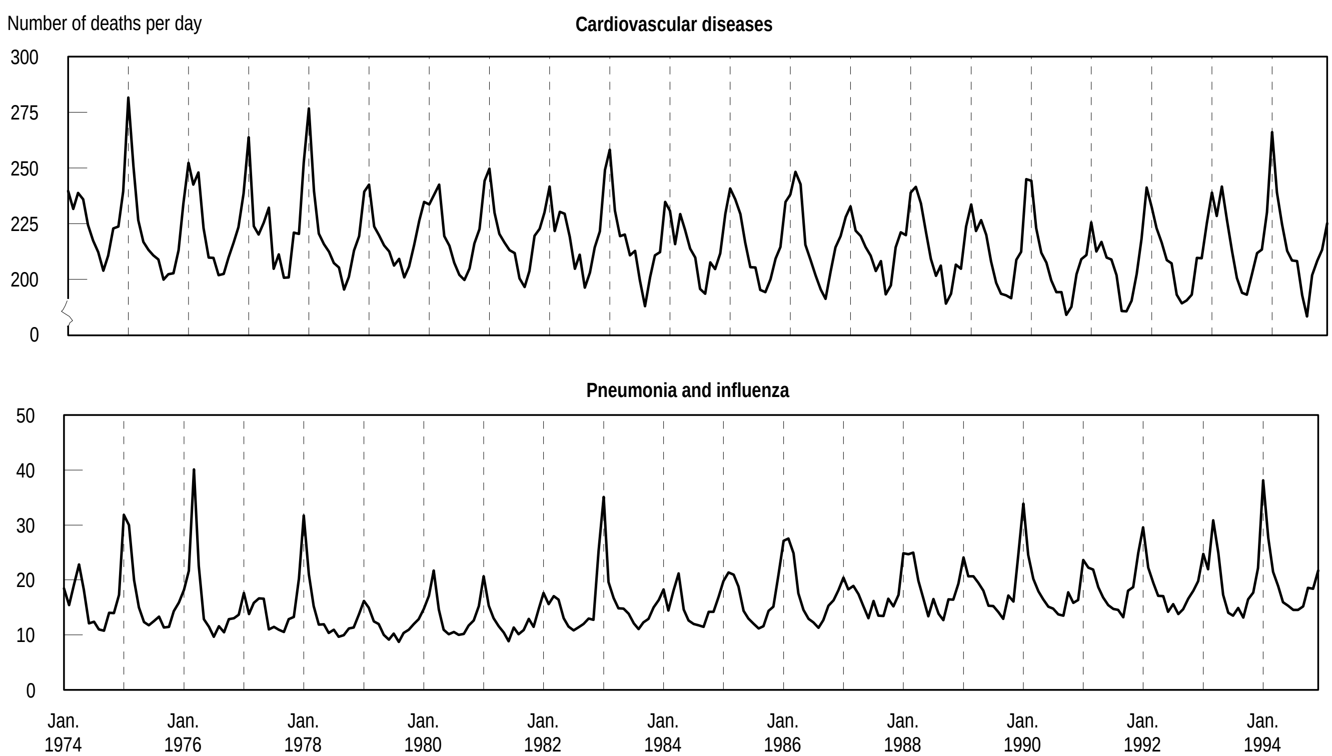
According to coding practices in Canada and most other countries, the underlying cause of death is defined as "(a) the disease or injury which initiated the train of morbid events leading directly to death, or (b) the circumstances of the accident or violence which produced the fatal injury."[9] For example, if a patient with a chronic cardiovascular disease contracts influenza followed by pneumonia and then death, the recorded cause of death would be the cardiovascular disease that "initiated" the events leading to death, even though influenza and pneumonia might have been more immediate causes.[11] This suggests that the seasonality of pneumonia and influenza contributes to the seasonality of deaths from other chronic diseases, even in non-epidemic years.

Since cardiovascular diseases account for a large percentage of deaths in Canada (44% over the 1974 to 1994 period), they have a great impact on the overall seasonality of deaths. From 1974 to 1994, the average daily number of deaths attributable to cardiovascular diseases crested in the winter months and bottomed out in the summer. Moreover, with the most notable exception occurring in 1976, whenever there was a pronounced increase in mortality due to pneumonia and influenza, there was usually a corresponding increase in deaths from cardiovascular diseases (Chart 4).

During the 1974 to 1994 period, the average daily number of deaths from cardiovascular diseases was usually highest in January and lowest in August. The seasonal peaks were about 13% above the average daily number, and the seasonal troughs, 10% below it.

Chart 4

Average daily number of deaths due to cardiovascular diseases and pneumonia and influenza, Canada, January 1974 to December 1994



Data source: *Canadian Vital Statistics Data Base*

Other winter peaks

Seasonality is also evident in deaths from several other causes whose occurrence would seem to have little relationship to the time of year. For example, the average daily numbers of deaths due to diabetes mellitus, chronic liver disease and cirrhosis, and diseases of the urinary system showed statistically significant seasonality similar to cardiovascular diseases, with all of them peaking in January. These chronic diseases have multiple systemic effects that can compromise individuals' health and make them more vulnerable to pneumonia and influenza.

Summer accidents

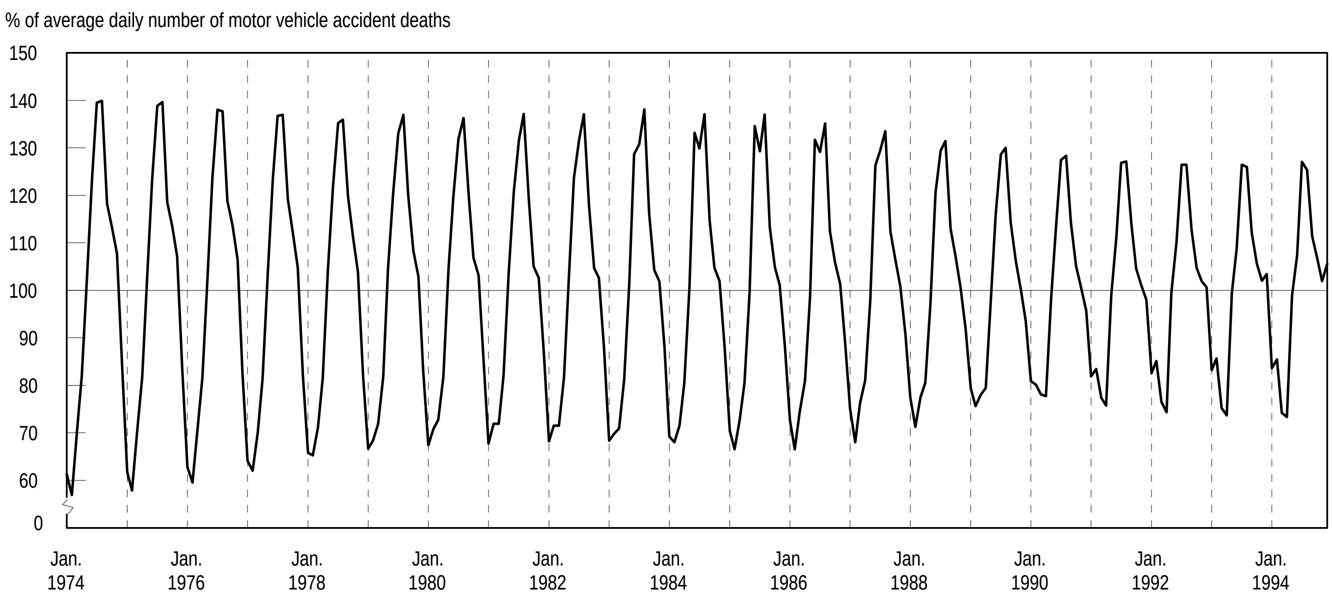
Motor vehicle accidents accounted for just 2.5% of deaths in the 1974 to 1994 period and so had little effect on the overall seasonality of mortality. In fact, the seasonal pattern for motor vehicle accident deaths was the inverse of the situation for deaths as a whole. Motor vehicle accident deaths crested in July or August and bottomed out in January or February, and in more recent years, in March or April.

Since 1974, the average daily number of motor vehicle accident deaths has declined, and the seasonal pattern has become less pronounced. Seasonal peaks fell from around 40% to 27% above average between the early 1970s and the early 1990s; the depth of the troughs declined from around 43% to about 25% below average. As a result, the seasonal amplitude narrowed substantially from over 80% to around 50% (Chart 5). Technological improvements in the design of vehicles and highways, campaigns against drinking and driving, seat belt legislation, and greater enforcement of traffic regulations may have contributed to the decline in motor vehicle accident death rates and dilution of the seasonal factor in these deaths.[12]

Traffic collision data compiled by Transport Canada reflect these motor vehicle accident mortality figures. For instance, three recent years of data, 1991 to 1993, show that fatal collisions increased in the summer months and decreased in the winter months.[13] The same was true for non-fatal collisions, but the peaks were much less pronounced. On the other hand, the number of

Chart 5

Seasonality of motor vehicle accident deaths, Canada, January 1974 to December 1994



Data source: *Canadian Vital Statistics Data Base*

collisions causing only property damage peaked in December and fell to a low in spring. This would seem to indicate that the higher mortality attributable to summer motor vehicle accidents is not a simple consequence of increased traffic volume leading to more collisions, as might be suspected, but of greater severity of collisions, possibly due to factors such as speed.

Suicides peak in spring

Some seasonality in suicides can be measured, but much less than for several other causes of death. The average daily number of suicides tended to peak in spring. In many years, there was a secondary rise in the fall.

The monthly pattern of suicides has also changed somewhat since the mid-1970s (Chart 6). While recent seasonal peaks were in March, in earlier years the peaks occurred in April through June. Throughout the period, the seasonal peaks were about 9% above average.

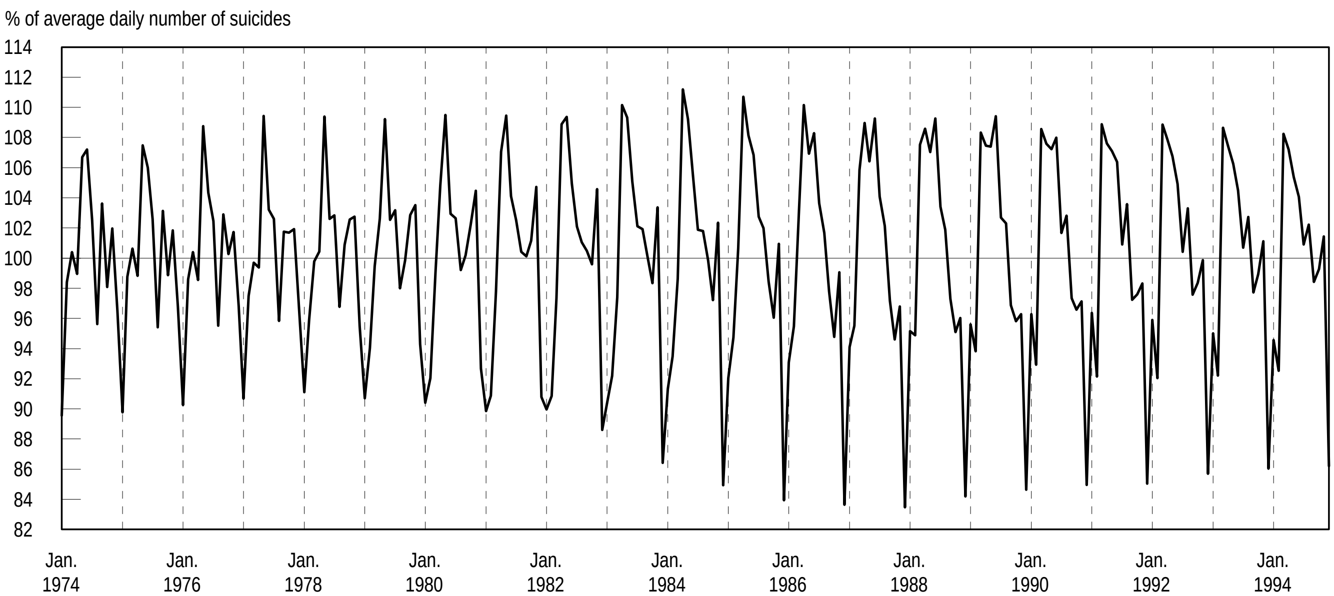
Although the "holiday season" is commonly thought to bring more suicides, this period actually marks the seasonal troughs for suicides. Moreover, these troughs have become slightly more pronounced, increasing from 10% to 14% below average. Consequently, the amplitude widened from 18% to 22%. Suicides, however, accounted for only 1.9% of all deaths during the 1974 to 1994 period.

Weekends dangerous

Not only are deaths more likely to occur in some seasons than in others, but some days of the week tend to be especially hazardous. Throughout the 1974 to 1994 period, Saturday saw the highest average daily number of deaths, and Thursday, the lowest.

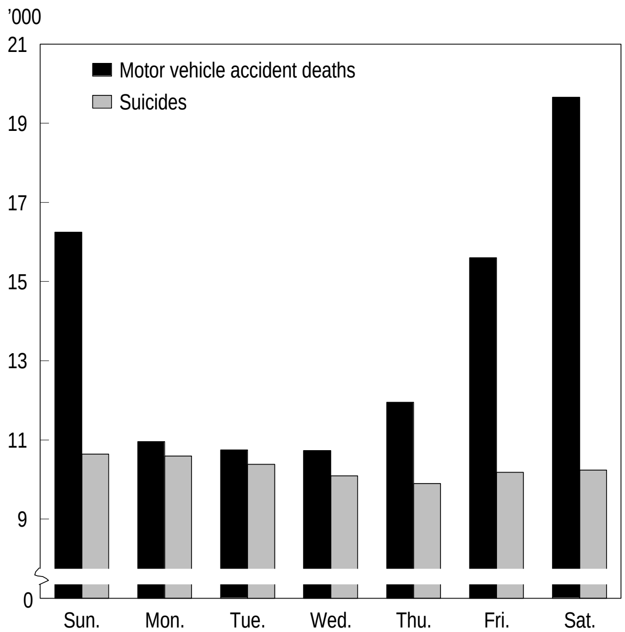
Differences in the average number of deaths across the days of the week also prevail for specific causes. Not surprisingly, motor vehicle accident deaths increase as the weekend approaches, beginning to rise on Thursday, peaking on Saturday, decreasing somewhat on Sunday and dropping sharply from Monday through Wednesday (Chart 7). By contrast, the daily pattern for suicide is relatively stable.

Chart 6
Seasonality of suicides, Canada, January 1974 to December 1994



Data source: *Canadian Vital Statistics Data Base*

Chart 7
Motor vehicle accident deaths and suicides, by day of week, Canada, 1974 to 1994 combined



Source: *Canadian Vital Statistics Data Base*

Concluding remarks

The winter upturn in deaths is associated with the increase in influenza and pneumonia during that season. However, public health measures might be able to mitigate this effect. For example, flu shots, particularly for high-risk groups, might lessen the magnitude of the winter peak in deaths, and in turn, reduce deaths ascribed to other causes that were triggered by pneumonia and influenza.

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Data Releases

This section presents synopses of recent health information produced by Statistics Canada.

Cancer Incidence in Canada, 1969 to 1993

Age-standardized rates for all cancers among both sexes rose steadily between 1969 and 1993. However, since 1984, the pace of increase has been relatively flat for women, but somewhat faster for men. Despite these comparatively small increases in overall incidence rates, the number of cancers has more than doubled from about 50,000 in 1969 to 117,000 in 1993. The number of cancers diagnosed each year will continue to rise as the Canadian population grows and ages.

The increase in incidence rates among men over the past decade is largely due to the upsurge in prostate cancer, now the leading form of cancer incidence among men. The rate of increase of this cancer has been particularly pronounced since the introduction of the PSA screening test in 1990. In 1993, 137.9 men in every 100,000 were diagnosed with prostate cancer, an increase from rates of 91.9 in 1989 and 56.2 in 1969.

Increases in rates before 1984, while due in part to improved registration of cancers, also reflect the rising incidence of a number of cancers. Lung cancer, for example, accounted for about half of the increase in rates for all cancers among men and just over half among women between 1969 and 1984. Since the mid-1980s, however, lung cancer rates declined slightly among men, reflecting their reduced levels of smoking since the mid-1960s. At the same time, lung cancer has been the most rapidly increasing form of cancer among women. The rate in 1993 was four times the rate reported in 1969.

Cancer Incidence in Canada, 1969 to 1993 contains 25 years of cancer incidence data for Canada, the provinces and territories. The publication consolidates Statistics Canada's most currently available cancer incidence data and presents trends never before published at the national level. It contains incidence counts and age-specific and age-standardized rates for more than 20 major forms of cancer, as well as average annual percent changes in the age-standardized rates and data quality indicators by age group and by site. A historical perspective section highlights key trends in incidence and mortality rates with special attention to the four leading cancers—prostate, lung, breast and colorectal.

Cancer Incidence in Canada, 1969 to 1993 (85-566-XPB, $42) is now available. For further information, contact Leslie Gaudette (613-951-1740) or Judy Lee (613-951-1775), Health Statistics Division.

Postcensal Population Estimates

Each issue of *Health Reports* includes current quarterly population estimates. July 1, 1996 (preliminary) estimates are shown on the following page.

Preliminary postcensal population estimates, by sex and age group, Canada, provinces and territories, July 1, 1996

	Canada	Nfld	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta	B.C.	Yukon	N.W.T.
							'000						
Both sexes	**29,963.6**	**570.7**	**137.3**	**942.8**	**762.5**	**7,389.1**	**11,252.4**	**1,143.5**	**1,022.5**	**2,789.5**	**3,855.1**	**31.5**	**66.6**
<1	377.9	6.1	1.7	10.7	8.7	86.1	145.6	16.2	13.8	38.8	48.2	0.5	1.5
1-4	1,582.9	25.8	7.3	45.7	36.7	374.5	602.1	66.3	58.2	162.1	196.2	2.1	5.8
5-9	2,015.8	36.7	10.0	63.1	49.3	462.3	761.9	83.1	79.7	211.6	247.6	2.4	8.1
10-14	2,019.6	43.0	10.1	63.7	52.2	465.9	746.8	81.1	82.0	213.1	253.2	2.5	6.1
15-19	2,002.9	44.7	10.1	63.5	53.3	502.6	721.7	78.5	76.5	196.6	247.8	2.2	5.3
20-24	2,036.3	46.6	9.8	66.5	56.9	478.8	757.6	81.0	70.0	197.1	264.4	2.2	5.5
25-29	2,223.5	45.3	9.8	68.7	57.0	519.7	858.2	81.5	64.3	216.0	294.3	2.4	6.3
30-34	2,631.2	47.1	11.0	80.6	64.6	643.2	1,023.4	93.8	77.7	249.1	330.7	3.3	6.7
35-39	2,666.4	48.0	11.0	82.0	64.6	675.4	996.7	94.4	82.9	263.6	338.8	3.2	5.7
40-44	2,387.5	46.9	9.9	73.8	61.1	610.0	874.6	85.2	75.6	230.9	311.8	3.0	4.6
45-49	2,159.5	42.6	9.8	69.3	56.9	553.5	804.4	75.9	62.9	190.4	287.6	2.7	3.7
50-54	1,672.2	32.4	7.4	53.6	42.2	455.1	616.5	58.8	48.0	139.2	214.9	1.8	2.3
55-59	1,332.6	24.4	6.0	42.7	33.3	349.9	503.3	47.7	41.9	109.5	171.2	0.9	1.7
60-64	1,213.1	20.9	5.6	38.5	30.1	315.4	462.4	44.6	40.6	97.4	155.6	0.8	1.3
65-69	1,129.3	18.6	5.0	34.5	27.7	290.8	433.9	42.7	39.9	87.1	147.4	0.7	1.0
70-74	979.9	15.9	4.5	30.7	25.6	243.5	378.3	40.3	36.9	72.0	131.3	0.4	0.5
75-79	704.3	12.4	3.7	25.2	19.2	168.9	261.6	31.4	30.8	52.8	98.0	0.2	0.3
80-84	467.6	8.0	2.6	16.9	13.1	109.1	170.9	22.7	22.5	34.8	66.8	0.1	0.2
85-89	240.6	3.8	1.4	8.7	6.9	56.7	87.9	11.8	11.9	17.9	33.4	0.0	0.1
90+	120.5	1.6	0.8	4.5	3.2	27.6	44.6	6.4	6.5	9.3	15.9	0.0	0.1
Males	**14,845.0**	**285.2**	**67.7**	**464.3**	**377.3**	**3,642.6**	**5,560.5**	**567.4**	**507.8**	**1,404.6**	**1,916.8**	**16.1**	**34.6**
<1	194.0	3.1	0.9	5.5	4.4	44.2	74.7	8.4	7.1	20.0	24.8	0.2	0.8
1-4	811.9	13.2	3.8	23.7	18.6	191.9	308.5	33.9	29.9	83.5	100.9	1.0	3.0
5-9	1,031.3	18.8	5.1	32.4	25.3	236.5	390.0	42.8	40.6	108.3	126.0	1.3	4.1
10-14	1,031.9	21.8	5.2	32.4	26.6	237.7	382.0	41.8	41.7	109.1	129.3	1.2	3.2
15-19	1,026.3	22.5	5.0	32.1	27.3	257.3	370.8	39.7	39.7	100.7	127.4	1.1	2.6
20-24	1,033.5	23.8	5.0	33.9	28.9	243.8	383.7	41.7	35.6	100.8	132.5	1.1	2.7
25-29	1,121.5	23.1	4.9	35.1	28.9	265.0	429.0	41.5	32.0	109.5	148.0	1.2	3.2
30-34	1,334.0	23.5	5.3	40.6	32.6	328.4	518.2	47.9	38.5	127.1	166.7	1.7	3.5
35-39	1,343.9	24.0	5.4	40.5	32.3	340.8	502.1	48.2	42.0	134.8	169.2	1.6	2.9
40-44	1,191.8	23.5	5.0	36.1	30.3	305.4	432.8	42.7	38.8	117.8	155.4	1.5	2.4
45-49	1,084.8	21.5	5.0	34.8	28.8	277.0	401.0	38.4	32.3	97.1	145.6	1.3	2.1
50-54	838.2	16.5	3.8	27.1	21.4	225.8	307.6	29.5	24.1	71.0	109.1	1.0	1.3
55-59	661.9	12.5	3.0	21.3	16.7	171.8	249.0	23.7	20.7	55.8	86.0	0.6	0.9
60-64	596.2	10.5	2.7	19.0	14.7	151.6	226.3	22.0	20.2	48.8	79.3	0.4	0.7
65-69	536.2	9.1	2.5	16.0	12.9	133.5	206.9	20.1	19.3	42.5	72.4	0.4	0.5
70-74	432.8	7.4	2.1	13.4	11.4	104.4	166.4	17.8	17.0	32.8	59.6	0.2	0.2
75-79	289.2	5.4	1.5	10.3	8.0	65.6	108.0	13.0	13.1	22.4	41.6	0.1	0.1
80-84	174.9	3.2	0.9	6.2	4.9	38.0	64.1	8.7	8.9	13.4	26.5	0.0	0.1
85-89	78.3	1.4	0.5	2.9	2.2	16.9	28.1	4.1	4.2	6.2	11.7	0.0	0.1
90+	32.5	0.5	0.2	1.1	0.9	6.9	11.5	1.6	2.1	2.9	4.7	0.0	0.0
Females	**15,118.6**	**285.5**	**69.6**	**478.5**	**385.2**	**3,746.6**	**5,691.9**	**576.1**	**514.7**	**1,385.0**	**1,938.3**	**15.3**	**31.9**
<1	184.0	3.0	0.8	5.2	4.3	41.9	70.9	7.9	6.7	18.9	23.4	0.2	0.7
1-4	771.0	12.6	3.5	22.0	18.0	182.6	293.7	32.4	28.4	78.6	95.2	1.1	2.8
5-9	984.5	17.9	4.9	30.7	24.0	225.8	372.0	40.2	39.1	103.4	121.6	1.1	3.9
10-14	987.7	21.1	4.9	31.3	25.6	228.2	364.8	39.3	40.3	104.0	123.9	1.2	2.9
15-19	976.5	22.2	5.1	31.4	26.0	245.3	350.9	38.8	36.8	95.9	120.4	1.1	2.7
20-24	1,002.9	22.8	4.8	32.6	28.0	234.9	373.9	39.3	34.4	96.3	132.0	1.1	2.7
25-29	1,102.1	22.2	4.9	33.6	28.1	254.7	429.2	40.0	32.3	106.5	146.3	1.2	3.0
30-34	1,297.2	23.6	5.6	40.0	32.0	314.8	505.2	46.0	39.1	122.1	164.0	1.6	3.2
35-39	1,322.5	24.1	5.6	41.5	32.3	334.6	494.6	46.2	40.8	128.9	169.6	1.7	2.7
40-44	1,195.7	23.5	4.9	37.6	30.8	304.5	441.9	42.6	36.8	113.1	156.4	1.5	2.1
45-49	1,074.7	21.1	4.8	34.5	28.1	276.5	403.5	37.5	30.6	93.3	142.0	1.3	1.6
50-54	834.0	15.9	3.6	26.5	20.8	229.4	308.9	29.2	23.9	68.2	105.8	0.8	1.0
55-59	670.7	11.9	3.0	21.5	16.6	178.1	254.3	24.0	21.2	53.8	85.2	0.4	0.7
60-64	616.9	10.3	2.9	19.5	15.4	163.8	236.1	22.6	20.4	48.6	76.3	0.4	0.7
65-69	593.1	9.5	2.5	18.5	14.8	157.3	227.0	22.6	20.6	44.6	74.9	0.3	0.5
70-74	547.1	8.5	2.4	17.3	14.2	139.1	211.8	22.5	19.9	39.2	71.7	0.2	0.2
75-79	415.1	7.0	2.2	14.9	11.2	103.2	153.6	18.4	17.7	30.4	56.4	0.1	0.1
80-84	292.7	4.9	1.7	10.7	8.1	71.1	106.8	14.1	13.6	21.4	40.3	0.1	0.1
85-89	162.3	2.4	1.0	5.8	4.6	39.8	59.8	7.7	7.7	11.7	21.7	0.0	0.0
90+	88.0	1.1	0.6	3.4	2.3	20.7	33.1	4.7	4.4	6.3	11.2	0.0	0.0

Source: *Demography Division, Population Estimates Section*
Note: *The population estimates are adjusted for net census undercoverage and include non-permanent residents.*

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	· ASCII and IVISION	82F0001XCB95001	CD-ROM	$1,600	$1,600	$1,600
Residential care	· ASCII	82M0010XDB	Diskette	$ 500	$ 500	$ 500

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