



Catalogue no. 82-003-XPB

Health Reports

Autumn 1997 Volume 9 No. 2

- Hormone replacement therapy
- Causes of death
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Research Articles

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

Characteristics of women on hormone replacement therapy

Marie P. Beaudet, Wikke Walop and Christel Le Petit

Abstract

Objectives

This article examines the use of hormone replacement therapy (HRT) among women aged 45-64 in light of their characteristics that might be related to benefits and risks associated with HRT.

Data source

The data are from the household component of the 1994/95 National Population Health Survey.

Analytical techniques

Odds ratios from multiple logistic regression were calculated to identify personal and health-related factors, measures of health care utilization, and behavioural risk factors that could be associated with HRT use.

Main results

In 1994/95, 22% of women aged 45-64 reported HRT use. Compared with older women, those who were aged 50-54 had higher odds of taking HRT. Women who reported at least one contact with a physician in the year before their interview, or who reported having had a mammogram or a blood pressure check also had high odds of using HRT. Smoking, drinking, regular exercise, contact with an alternative medicine provider, weight, and mental status were not significantly related to HRT use.

Conclusion

Women who are users of the health care system have relatively high odds of taking HRT. However, the data do not indicate that women who are in better health or who appear to have healthier lifestyles are more likely to be HRT users.

Key words

menopause, synthetic hormones, estrogen, progesterone

Authors

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Women currently experiencing symptoms of menopause and those approaching it suffer no lack of information about hormone replacement therapy (HRT). In 1996 alone, the popular press in Canada mentioned HRT 152 times,¹ an average of one reference almost every other day. The scientific literature, as referenced in MEDLINE, yielded 257 citations about HRT for that year.

The use of hormone replacement therapy is not a clear choice, in part because results from scientific studies of the risks and benefits are limited and often contradictory, especially if long-term use is considered (see *Scientific evidence*).² The decision to use or not to use HRT is not straightforward, so clinicians have devised guidelines to assist women in making the choice.³⁻⁶

The current debate about HRT is fueled by the millions of women of the baby boom generation who will begin to experience menopausal symptoms over the next decade. The debate also has philosophical and ethical dimensions. These include reservations about medicalizing a natural process (menopause) and turning it into a condition that

Methods

Data source

The data are from Statistics Canada's 1994/95 National Population Health Survey (NPHS), a longitudinal survey that measures the health status of the Canadian population. Data collection for the first wave began in June 1994 and finished in the summer of 1995.^{7,8}

The target population was household residents in all provinces and territories, except persons living on Indian reserves, on Canadian Forces bases, or in some remote areas. A total of 26,430 households were selected for the survey. The final response rate was approximately 89% of households. An additional institutional component covered long-term residents of hospitals and residential care facilities. Data from the institutional component and the territories are not included in this analysis.

The household survey collects most of the information from one adult household member who is knowledgeable about the health of all members of the household. In-depth health information is also collected from a randomly selected household member. Among randomly selected respondents, the response rate was 96%. Detailed information about NPHS content and sample design has been published elsewhere.^{7,8}

As part of the NPHS interview, female respondents aged 30 and over were asked: "In the past month, did you take hormones for menopause or aging symptoms?" Women who reported use of one or more such medications during the last month were asked if they had taken medications during the last two days and what type of medication they took. Those who reported taking estrogen with or without progesterone in the last two days, as well as those who reported taking hormones for menopause or aging symptoms in the past month, were classified as HRT users.

For this analysis, HRT was dichotomized as being used or not being used. The analysis is based on women aged 45-64 who responded to the in-depth interview (2,355 respondents). In 39 cases, the information was provided by proxy respondents because the selected women were not able to answer or could not be contacted. For the majority of proxy interviews (33), the women were classified as non-HRT users.

Analytical techniques

A number of personal characteristics, health care utilization measures, physical and mental health status indicators and health behaviour variables were examined (see *Definitions*). The selection

of these variables was guided by findings from previous studies. Multiple logistic regression was used to identify the characteristics associated with HRT use. Table 1 lists the independent variables that were included in the model.

The multivariate analysis is based on 2,117 women aged 45-64 who reported information on all the variables selected for inclusion in the model (238 were missing information on one or more variables). Of this group, 454 (21%) were on HRT and 1,663 (79%) were not. They represented about 2,996,400 non-institutionalized women living in the 10 provinces.

Responses were weighted using the survey weights, which were normalized so that they averaged 1. Normalization of the weights does not take into account the complex multi-cluster sample design of the NPHS and produces standard errors that tend to be too small.⁹⁻¹¹ To address this problem, the jackknife approach for the estimation of the variance was used to calculate confidence intervals for the odds ratios of the logistic regression.¹²

Limitations

Although NPHS data are self-reported, recall of HRT use has been shown to be fairly accurate.¹³ As well, recall bias should be small because respondents were asked about drug use that occurred within the past month. However, as with all self-reported data, it is not possible to determine the proportion of women who chose not to disclose their use of hormones. Information on surgical menopause and length of time on HRT, which would have refined the profile of HRT users, is not available from the NPHS.

Details about the type of therapy and the dose were not collected in the NPHS. Therefore, information on the proportion of women who use estrogen opposed with progesterone and women who only use estrogen is not available.

Many factors, notably chronic conditions, may not have contributed to the model for lack of statistical power. This is the case for diabetes, heart disease, cancer, the effects of stroke, and urinary incontinence.

The NPHS indicators were not tailored to specifically address issues related to differences between HRT users and non-users. For example, the finding that women on HRT do not appear to be in better health or have healthier lifestyles could be attributed to the lack of sensitivity of the indicators selected to measure these dimensions.

requires decades of treatment. The role of pharmaceutical companies, for whom widespread adoption of HRT could translate into sizable financial gain, has also been questioned.¹⁴ (In 1996, 2.86 million prescriptions were written for HRT, although just under 2 million were filled, perhaps indicating some women's ambivalence about this treatment.¹⁵) In addition, the societal expectation that women should maintain the characteristics of youth as they grow older has been identified as a non-medical factor in the equation.

Critics caution that some of the apparently favourable effects may be related to the characteristics of women who use HRT and of those who agree to participate in HRT studies.^{2,16} The majority of such research is based on epidemiological or observational studies (cohort or case-control). As a consequence, biases such as self-selection may influence the results. For example, some researchers have found HRT users to be healthier and to include mostly women who do not have a history of high blood pressure.^{17,18} Thus,

Definitions

Marital status was grouped into three categories: married, previously married, and single. Women in common-law relationships or living with a partner were included in the "married" category. "Previously married" refers to those who were divorced, separated, or widowed. "Single" refers to women who never married.

Household income is a derived measure of income adequacy based on household size.

Respondents were classified as *daily smokers* if they reported that they smoked cigarettes on a daily basis.

Respondents who reported consuming alcohol in the last 12 months were classified as *regular* or *occasional drinkers*.

Regular exercise was defined as engaging 12 or more times a month in recreational physical activity that lasts more than 15 minutes. Details of the calculations to obtain average daily energy expenditure can be found in the *National Population Health Survey Overview 1994-95*.⁷

To measure the prevalence of *chronic conditions*, respondents were asked, "Do(es) ... have any of the following long-term conditions that have been diagnosed by a health professional: ...? A list was read to respondents, who were instructed to identify as many conditions as were applicable. The conditions retained for this analysis are: arthritis or rheumatism, back problems excluding arthritis, high blood pressure, migraine headaches, diabetes, heart disease, cancer, effects of stroke, and urinary incontinence. The severity of each condition was not recorded.

To assess *perceived health status*, respondents were asked, "In general, would you say your health is excellent? very good? good? fair? poor?" For this analysis, responses were grouped into three categories: poor or fair, good or very good, and excellent.

Body mass index (kg/m²) was calculated from self-reported height and weight. Respondents with a score of 25 or more were considered *overweight*.

Depression was assessed using the methodology of Kessler et al.,¹⁹ with a subset of questions from the Composite International Diagnostic Interview. These questions cover a cluster of symptoms for depressive disorder, which are listed in the *Diagnostic and Statistical Manual of Mental Disorders*.²⁰ Responses to these questions are scored and transformed into an estimate of the probability of a diagnosis of a major depressive episode (MDE). If this estimate is 0.9 or greater, that is, if there is a 90% certainty of a diagnosis, then the respondent is considered to have experienced an MDE in the previous 12 months.

To assess *thinking ability*, respondents were asked: "How would you describe your usual ability to think and solve day to day problems?" They could choose one of the following: "able to think clearly and solve problems," "having a little difficulty," "having some difficulty," "having a great deal of difficulty," or "unable to think or solve problems." Only those who reported that they were able to think clearly and solve problems were classified as usually having good thinking ability.

To assess *memory*, respondents were asked: "How would you describe your usual ability to remember things?" Four response options were presented: "able to remember most things," "somewhat forgetful," "very forgetful," and "unable to remember anything at all." Those who reported that they were able to remember most things were classified as usually having a good memory.

Scientific evidence

In addition to relieving the symptoms of menopause (hot flashes, vaginal dryness, insomnia, irritability, lack of energy, and feelings of depression), hormone replacement therapy has a number of other health benefits. For instance, it has been shown to protect against both heart disease and osteoporosis, the prevalence of which rises dramatically among postmenopausal women. However, the results of studies of HRT have, at times, been contradictory.

Comprehensive literature reviews indicate an estimated 35% to 50% decreased risk of coronary heart disease among postmenopausal women taking estrogen.²¹ Clinical research has demonstrated that orally administered estrogen, with or without progesterone, lowers low-density lipoprotein (LDL or “bad” cholesterol) and increases the levels of high-density lipoprotein (HDL or “good” cholesterol).²² Women with low HDL levels are at higher risk of heart disease. Estrogen may also promote vessel relaxation under pressure and the formation of new blood vessels.^{22,23}

Osteoporosis is a loss of bone density and is related to the high incidence of hip fracture in older women.²⁴⁻²⁶ Osteoporotic fractures are an important cause of death, with an estimated one in five women who fracture a hip dying in the year after the fracture.²⁵ Results of a meta-analysis show consistent evidence of the beneficial effects of estrogen in reducing the risk of hip fracture.²⁴ In fact, HRT is the preferred treatment for osteoporosis, with other regimes being considered only when the prescribed HRT fails to work or when a patient's health profile or preferences dictate an alternate approach.

According to a recent American study, HRT would lower the risk of osteoarthritis of the hip in white women aged 65 and older, potentially reducing the need for surgery and rehabilitation.²⁷

HRT seems to help preserve not only bones, but also skin elasticity, by slowing the breakdown of collagen. Losing collagen makes skin thinner, drier, less resilient and more prone to wrinkles.²⁴

Finally, HRT may have positive effects on the brain.²⁸ It has been associated with verbal memory in older women.²⁹ Improvements in memory, alertness, sleep patterns and social behaviour of women with mild or moderate symptoms of Alzheimer disease have also been reported.^{30,31}

But HRT is not without a downside, including a slightly higher risk of breast cancer.^{24,32} HRT may also affect the results of mammography, thus raising anxiety among women with false positive results. In one study, HRT users aged 50 and over were more likely than nonusers to get false positive mammograms.³³

Moreover, the health effects of long-term HRT are not well known.^{2,24,32,34} Few studies have examined the effect of regular

and prolonged use of estrogen with progesterone, but information on the effect of long-term use of estrogen alone is available.^{2,34} Long-term use (11 years or more) of estrogen replacement therapy (ERT) yielded a 70% increased risk of mortality from ovarian cancer.³⁵ Other research has shown the risk of breast cancer to have increased after five to nine years of ERT use and to almost double for women aged 60 and over.³⁶

A review of the literature found extensive and consistent evidence in support of estrogen therapy or “unopposed” therapy decreasing the risk of coronary heart disease and hip fracture, but long-term use increases the risk of endometrial cancer, and weak evidence substantiates a small increase in the risk of breast cancer.²⁴ Estrogen combined with a progestin-“opposed” estrogen reduces the risk of endometrial cancer, but the decreased risk of coronary heart disease obtained with the unopposed therapy is probably negated and there is an increased risk for breast cancer. However, these authors caution that their conclusions are based on data abstracted from observational studies and that the effect of the combined therapy of estrogen plus a progestin has not been adequately studied.

Other researchers anticipate gains in life expectancy of up to three years, depending on a woman's risk for coronary heart disease, hip fracture, breast cancer and endometrial cancer.³⁷ Their conclusion is that the beneficial effects of HRT with regard to coronary heart disease are impressive, and that most women who have just completed menopause should benefit from it. Women not likely to benefit from this therapy are those with no risk factors for coronary heart disease or hip fracture or with two first-degree relatives with breast cancer. These researchers, too, caution that the data used to model gains in life expectancy are from observational studies.

In fact, most of the research on the effects of HRT is based on observational studies. That is, a group of women taking HRT are studied for a number of years to determine whether they derive any health benefits. The problem with such an approach is that it does not indicate whether HRT lowers the risk of, for example, heart disease, or whether the type of woman who has the lowest risk of heart disease is also the type likely to use HRT.

Thus, despite all the research, the use of HRT is not an obvious decision. On balance, short-term use does not appear to increase risks, and that is why it has been recommended that HRT be offered to post-menopausal women.^{38,39} However, new drugs continue to be introduced. Selective estrogen-receptor modulators that reduce coronary heart disease, strengthen bones, and do not increase the risk of breast and uterine cancer may drastically simplify that choice.⁴⁰

HRT use may be more prevalent among healthy and health-conscious women who adopt it as part of a larger disease prevention effort. Such women may be better-educated, less likely to smoke, and more likely to exercise regularly.^{16,41}

This article is the first national report of HRT use among Canadian women. It draws upon data from the National Population Health Survey (NPHS) to examine factors associated with HRT use (see *Methods*). The analysis focuses on women aged 45-64, the age group most likely to be examining the pros and cons of hormone replacement therapy.

The prescription of hormones can vary. Some women are prescribed estrogen only or “unopposed” estrogen (ERT). Others are prescribed estrogen along with a progestin agent, referred to as “opposed” estrogen (HRT). For simplicity, the term HRT is employed in this article to refer to all hormones, opposed or unopposed, that respondents reported they were taking for menopausal symptoms.

HRT use peaks among women in their fifties

Despite inconsistent scientific evidence, a large number of Canadian women have decided to use HRT. According to the 1994/95 NPHS, 22% of women aged 45-64—an estimated 648,000—reported using some form of hormone replacement therapy for menopause or aging symptoms in the month before they were interviewed. Use was highest among those aged 50-54 (33%), a time when symptoms of menopause are likely to be most numerous and intense (Chart 1). At older and younger ages, smaller proportions of women were using HRT.

When other factors that might affect HRT use were accounted for, the odds that women in their early fifties would use it were significantly higher than the odds for women aged 60-64 (odds ratio 2.3) (Table 1). Older women may discontinue HRT when symptoms are less bothersome or because of the fear of an increased risk of cancer and other side effects associated with long-term use, or they may never have used HRT. However, it is not

possible with NPHS data to assess whether lower HRT use among older women results from their refusing the therapy, discontinuing it, or not being offered it by their physicians.

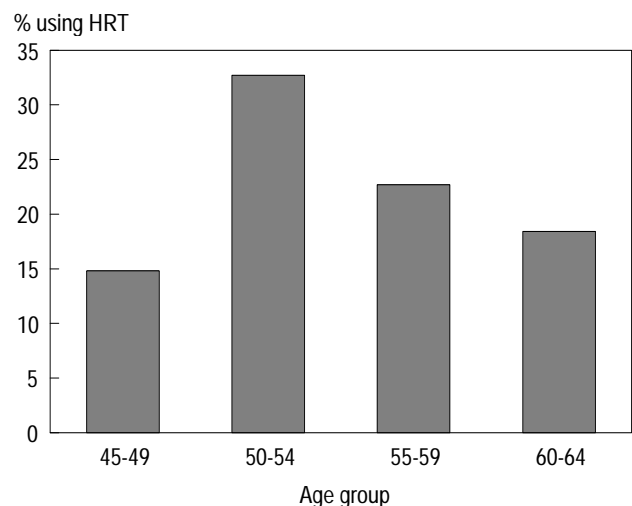
Race a significant factor

Several demographic and socioeconomic variables that might be expected to be associated with HRT use had little bearing on whether or not women used it. HRT use was highest—24%—among those who were previously married (widowed, divorced or separated), followed by married (22%), and then single (18%) women (Table 2). But controlling for other variables, the odds that married or previously married women would use HRT were no greater than for single women.

As well, HRT use appeared to be highest among women with some postsecondary education (26%) and among those from households with higher incomes (24%). But again, these differences were not significant.

By contrast, race was significantly related to the use of hormones. The odds that white women were HRT users were about three times the odds for women of other races (odds ratio 2.9).

Chart 1
Rates of HRT use, by age group, women aged 45-64, Canada, 1994/95



Data source: National Population Health Survey, 1994/95

Table 1

Odds ratios for use of hormone replacement therapy, women aged 45-64, Canada, 1994/95

Independent variable	Odds ratio	95% confidence interval	Independent variable	Odds ratio	95% confidence interval	Independent variable	Odds ratio	95% confidence interval
Personal characteristics			Pap test in last year			High blood pressure		
Age group			No†	1.0	...	No†	1.0	...
45-49	.7	.5, 1.2	Yes	1.0	.7, 1.4	Yes	.8	.6, 1.2
50-54	2.3*	1.5, 3.6	Mammogram in last two years			Migraine headaches		
55-59	1.4	.9, 2.1	No†	1.0	...	No†	1.0	...
60-64†	1.0	...	Yes	1.6*	1.1, 2.2	Yes	1.5	1.0, 2.2
Marital status			Blood pressure check in last year			Diabetes		
Married	1.3	.7, 2.3	No†	1.0	...	No†	1.0	...
Previously married	1.4	.7, 2.7	Yes	2.5*	1.4, 4.3	Yes	.8	.3, 2.1
Single†	1.0	...	Health behaviours			Heart disease		
Educational attainment			Daily smoker			No†	1.0	...
Less than high school graduation†	1.0	...	No†	.9	.6, 1.3	Yes	.7	.4, 1.4
High school graduate	1.0	.6, 1.6	Yes	1.0	...	Cancer		
Some postsecondary	1.3	.9, 1.9	Regular or occasional drinker			No†	1.0	...
Postsecondary graduate	1.0	.7, 1.5	No	.8	.5, 1.2	Yes	.4	.2, 1.0
Household income			Yes†	1.0	...	Effects of stroke		
Low†	1.0	...	Regular exercise			No†	1.0	...
Middle	.8	.4, 1.4	No†	1.0	...	Yes	1.1	.2, 5.2
High	1.0	.5, 1.8	Yes	.9	.7, 1.3	Urinary incontinence		
Canadian-born			Overweight			No†	1.0	...
No†	1.0	...	Yes†	1.0	...	Yes	1.2	.5, 3.2
Yes	1.0	.7, 1.5	No	1.3	.9, 1.7	Mental health status		
Race			Physical health status			Depressed		
White	2.9*	1.1, 7.9	Poor or fair	1.4	.5, 3.7	No†	1.0	...
Other†	1.0	...	Good or very good	1.5	.5, 4.1	Yes	1.0	.6, 1.9
Worked in last year			Excellent†	1.0	...	Ability to think usually good		
No†	1.0	...	Broken bone in last year			No†	1.0	...
Yes	.8	.6, 1.2	No	.9	.3, 3.0	Yes	1.1	.7, 1.5
Health care utilization			Yes†	1.0	...	Used anti-depressants in last two days		
Talked to medical doctor in last year			Arthritis or rheumatism			No†	1.0	...
No†	1.0	...	No†	1.0	...	Yes	2.2*	1.2, 4.1
Yes	2.1*	1.1, 4.1	Yes	1.2	.9, 1.7			
Talked to alternative health care provider			Back problems excluding arthritis					
No†	1.0	...	No†	1.0	...			
Yes	1.7	1.0, 2.7	Yes	1.5*	1.1, 2.2			

Data source: National Population Health Survey, 1994/95

Notes: Odds ratios are from a multivariate logistic regression. Confidence intervals were estimated using the jackknife approach to the estimation of the variance. The analysis is based on 2,117 women aged 45-64; 238 female respondents in this age range (10%) who were missing information on one or more of the variables included in the analysis were excluded.

† Reference category, for which the odds ratio is 1.0

... Figures not applicable

* $p \leq 0.05$

Users of health services

The women taking HRT tended to have used other health services. They were likely to have consulted physicians in the previous year and to report having had medical tests such as mammograms and blood pressure checks.

Physicians do not usually write prescriptions for HRT that extend beyond a year. As well, a yearly check-up is recommended to monitor women on HRT, even those who are in good health. Therefore,

it is not surprising that the odds of women who had contacted a medical doctor in the previous year being HRT users were double those of women who had not had such contact (odds ratio 2.1).

The odds that women who had had a mammogram in the past two years were HRT users were significantly higher (odds ratio 1.6) than those of women who had not. Because of the possibility that HRT can increase the risk of breast cancer, physicians who prescribe it are also likely to refer

Table 2
Rates of use of hormone replacement therapy, women aged 45-64, Canada, 1994/95

Variables	% on HRT	Variables	% on HRT	Variables	% on HRT
Personal characteristics					
Age group		Pap test in last year		High blood pressure	
45-49	14.8	No	17.6	No	21.9
50-54	32.6	Yes	27.4	Yes	21.1
55-59	22.7	Mammogram in last two years		Migraine headaches	
60-64	18.4	No	15.0	No	20.6
Marital status		Yes	27.6	Yes	31.2
Married	21.6	Blood pressure check in last year		Diabetes	
Previously married	23.7	No	8.5	No	22.0
Single	18.1	Yes	25.6	Yes	--
Educational attainment		Health behaviours		Heart disease	
Less than high school graduation	20.2	Daily smoker		No	21.8
High school graduate	19.8	No	21.6	Yes	--
Some postsecondary	26.3	Yes	22.6	Cancer	
Postsecondary graduate	21.4	Regular or occasional drinker		No	22.0
Household income		No	17.8	Yes	--
Low	22.4	Yes	23.2	Effects of stroke	
Middle	19.2	Regular exercise		No	21.8
High	24.0	No	21.3	Yes	--
Canadian-born		Yes	22.5	Urinary incontinence	
No	19.1	Overweight		No	21.7
Yes	22.5	Yes	20.8	Yes	--
Race		No	23.1	Mental health status	
White	22.8	Physical health status		Depressed	
Other	--	Perceived health status		No	21.5
Worked in last year		Poor or fair	13.9	Yes	28.4
No	22.0	Good or very good	21.6	Ability to think usually good	
Yes	21.5	Excellent	24.4	No	23.6
Health care utilization		Broken bone in last year		Yes	21.6
Talked to medical doctor in last year		No	21.7	Ability to remember usually good	
No	--	Yes	--	No	21.5
Yes	24.5	Arthritis or rheumatism		Yes	21.9
Talked to alternative health care provider		No	19.8	Used anti-depressants in last two days	
No	20.7	Yes	28.0	No	20.7
Yes	33.7	Back problems excluding arthritis		Yes	45.6
		No	20.0		
		Yes	29.9		

Data source: National Population Health Survey, 1994/95

Note: The sample of 2,355 was weighted to represent 2,996,400 non-institutionalized women aged 45-64.

-- Amount too small to be expressed

patients for mammography. In addition, the risk of breast cancer is often mentioned in the popular media, so women using HRT may either request that their doctor arrange for a mammogram or get one through the organized breast screening program in their province.^{42,43}

Similarly, HRT use was high among women who had had their blood pressure checked in the previous year. The odds that women who had had a blood pressure check would be HRT users were more than double those of women who had not (odds ratio 2.5). This is not surprising, since blood pressure monitoring is almost always part of a yearly check-up.

By contrast, HRT use was not associated with Pap smears. The odds that a woman who had had a Pap smear in the previous year would be an HRT user were not significantly different from those for a woman who had not. However, the recommended screening frequency is every three years until age 69 (after two normal smears),⁴⁴ so it is less likely that women on HRT would have had a recent Pap smear than other medical tests.

Despite attention that the mass media are currently devoting to the use of natural remedies to manage menopause symptoms, women who had contacted an alternative health care practitioner in the past year were no more or less likely to be HRT users than women who had not done so.

No significant health differences

NPHS data do not indicate that women who are healthier or have a more healthy lifestyle have high odds of using HRT.

Women aged 45-64 who perceived their health as less than excellent were no less likely than women with a more favourable self-assessment to use HRT. Consistent with this, the presence of a number of chronic conditions was not significantly associated with HRT use. Women with arthritis/rheumatism, high blood pressure, migraine headaches, diabetes, heart disease, cancer, the effects of stroke, and urinary incontinence were no less likely than women free of these conditions to use HRT. In some instances, however, the number of women using HRT who reported a chronic condition was so small

that differences may not have been detected because of a lack of statistical power.

The only chronic condition significantly associated with HRT use was non-arthritic back problems (odds ratio 1.5). This could be related to the loss of bone density among women with osteoporosis, who may benefit from hormone use.

As well as physical health, women's mental and emotional status bore little relationship to whether they used HRT. The association between HRT use and thinking ability, memory and depression was not significant. However, a high percentage of women who reported taking anti-depressants in the two days before their interview (46%) were also on HRT. The odds that women taking anti-depressants would use HRT were more than double those for women not taking anti-depressants (odds ratio 2.2). To some extent, the lack of a significant relationship between having suffered depression and HRT use may reflect this association between the use of anti-depressants and HRT.

Lifestyle not a significant factor

Differences in hormone use were not associated with variables that measure various health behaviours such as smoking, drinking, and exercise. Women who smoke are at greater risk for osteoporosis, heart disease and cerebrovascular disease, and they may be prescribed HRT to reduce the risk. However, the percentage of daily smokers reporting HRT use was virtually the same as that of occasional and non-smokers: 23% and 22%. Among regular and occasional drinkers, 23% reported HRT use; the proportion dropped to 18% among non-drinkers, but this did not yield statistically significant differences between the two groups in the odds that they would use HRT. The percentages of HRT users among women who did and did not report regular exercise were almost the same. Likewise, being overweight was not associated with hormone use.

Concluding remarks

In addition to relieving many of the symptoms of menopause, HRT lowers the risk of cardiac

problems and osteoporosis, and maintains a “younger look” in aging women.

Previous studies have suggested that the apparently beneficial results of HRT may be attributable to better health among women who are taking these medications. However, results of the National Population Survey do not support this premise. HRT users do not appear to be healthier than non-users. In a multivariate analysis, women with a variety of chronic conditions were no more or less likely to be on HRT than women who were not affected. Nor was HRT significantly associated with self-assessed health status. Similarly, lifestyle bore little relationship to HRT use: the relationships between smoking, drinking and regular exercise and HRT use were not significant.

Earlier research did, however, find HRT users to be health-conscious, a finding supported by the NPHS. In 1994/95, HRT users were concerned about their health to the extent that they had recently consulted physicians and had mammograms and blood pressure checks. Nonetheless, it is also possible that because some women agree or choose to use HRT, of necessity, they take better care of themselves. That is, they must visit their doctor, have their blood pressure checked, and perhaps even have a mammogram in order to have their prescriptions renewed for another year.

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References

- 1 Canadian Business and Current Affairs Index. Micromedia Ltd., File 262, 1997. Key words: hormone replacement therapy or HRT, 1996.
- 2 Adami H-O, Persson I. Hormone replacement and breast cancer: A remaining controversy? *Journal of the American Medical Association* 1995; 274(2): 178-9.
- 3 O'Connor A, Tugwell P, Elmslie T, et al. *Making choices: Hormones after menopause*. Ottawa: Loeb Medical Research Institute, Ottawa Civic Hospital, 1996.
- 4 Derzko CM. Indications for HRT in older women. *The Canadian Journal of Diagnosis* 1995; October: 40-59.
- 5 Derzko CM. Hormone replacement therapy: Helping women make an informed choice (Part I). *Journal of the Society of Obstetricians and Gynecologists of Canada* 1997; 19(3 Suppl): 1-10.
- 6 Derzko CM. Hormone replacement therapy: Helping women make an informed choice (Part II). The woman with breast or gynaecological malignancies. *Journal of the Society of Obstetricians and Gynecologists of Canada* 1997; 19(3 Suppl): 11-20.
- 7 Millar W, Beaudet MP, Chen J, et al. *National Population Health Survey Overview 1994-95* (Statistics Canada, Catalogue 82-567) Ottawa: Minister of Industry, 1995.
- 8 Tambay J-L, Catlin G. Sample design of the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(1): 29-38.
- 9 Pfeffermann D. The role of sampling weights when modeling survey data. *International Statistical Review* 1993; 61(2): 317-37.
- 10 Korn E and Graubard B. Analysis of large health surveys: Accounting for the sampling design. *Journal of the Royal Statistical Society* 1995; 158(Pt 2): 263-95.
- 11 McCarthy PJ. *Replication: An approach to the analysis of data from complex surveys*. U.S. Department of Health, Education, and Welfare (Vital and Health Statistics, Series 2, No. 14) Washington: U.S. Government Printing Office, 1966.
- 12 Wolter KM. *Introduction to Variance Estimation*. New York: Springer-Verlag, 1985.
- 13 Goodman MT, Nomura AMY, Wilkens LR, et al. Agreement between interview information and physician records on history of menopausal estrogen use. *American Journal of Epidemiology* 1990; 131(5): 815-25.
- 14 Love S. *Dr. Susan Love's Hormone Book*. New York: Random House, 1997.
- 15 IMS Canada. *Canadian Disease and Therapeutic Index and Canadian CompuScript*. Database. Montreal: IMS Canada, 1994.
- 16 Barrett-Connor E. Postmenopausal estrogen and prevention bias. *Annals of Internal Medicine* 1991; 115(6): 455-6.
- 17 Cauley JA, Cummings SR, Black DM, et al. Prevalence and determinants of estrogen replacement therapy in elderly women. Part 1. *American Journal of Obstetrics and Gynecology* 1990; 163(5): 1438-44.

- 18 Barrett-Conner E, Wingard DL, Criqui MH. Postmenopausal estrogen use and heart disease risk factors in the 1980s. *Journal of the American Medical Association* 1989; 261(14): 2095-100.
- 19 Kessler RC, McGonagle KA, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: Results from the National Comorbidity Survey. *Archives of General Psychiatry* 1994; 51: 8-19.
- 20 American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*, 3rd rev. ed. Washington, DC: American Psychiatric Association, 1987.
- 21 Stampfer MJ, Colditz GA, Willett WC. Menopause and heart disease: A review. *Annual New York Academy of Sciences* 1990; 592: 193-203.
- 22 Gura T. Estrogen: Key player in heart disease among women. *Science* 1995; 269: 771-3.
- 23 The Writing Group for the PEPI trial. Effects of estrogen or estrogen/progestin regimens on heart disease risk factors in postmenopausal women. The Postmenopausal Estrogen/Progestin Interventions (PEPI) trial. *Journal of the American Medical Association* 1995; 273(3): 199-208.
- 24 Grady D, Rubin SM, Petitti DB, et al. Hormone therapy to prevent disease and prolong life in postmenopausal women. *Annals of Internal Medicine* 1992; 117(12): 1016-37.
- 25 Cummings SR, Kelsey JL, Nevitt MC, et al. Epidemiology of osteoporosis and osteoporotic fractures. *Epidemiological Review* 1985; 7: 178-208.
- 26 Kiel DP, Felson DT, Anderson JJ, et al. Hip fracture and the use of estrogens in postmenopausal women. The Framingham study. *New England Journal of Medicine* 1987; 317(19): 1169-74.
- 27 Nevitt MC, Cummings ST, Lane NE, et al. Association of estrogen replacement therapy with the risk of osteoarthritis of the hip in elderly white women. *Archives of Internal Medicine* 1996; 156: 2073-80.
- 28 Kimura D. Sex differences in the brain. *Scientific American* 1992; 267(3): 119-25.
- 29 Sherwin BB. Estrogen, the brain and memory. *Menopause: The Journal of the North American Menopause Society* 1996; 3(2): 97-105.
- 30 Henderson VW. Alzheimer's disease in women: Is there a role for estrogen replacement therapy? *Menopause Management* 1995; December: 10-3.
- 31 Henderson VW, Paganini-Hill A, Emanuel CK. Estrogen replacement in older women: Comparison between Alzheimer's disease cases and nondemented control subjects. *Archives of Neurology* 1994; 51: 896-900.
- 32 Stanford JL, Thomas DB. Exogenous progestins and breast cancer. *Epidemiologic Reviews* 1993; 15(1): 98-107.
- 33 Laya MR, Larson EB, Taplin SH, et al. Effect of estrogen replacement therapy on the specificity and sensitivity of screening mammography. *Journal of the National Cancer Institute* 1996; 88(10): 644-9.
- 34 Stanford, JL, Weiss NS, Voigt LF, et al. Combined estrogen and progestin hormone replacement therapy in relation to risk of breast cancer in middle-aged women. *Journal of the American Medical Association* 1995; 274(2): 137-42.
- 35 Rodriguez C, Calle EE, Coates RJ, et al. Estrogen replacement therapy and fatal ovarian cancer. *American Journal of Epidemiology* 1995; 141(9): 828-35.
- 36 Colditz GA, Hankinson SE, Hunter, DJ, et al. The use of estrogens and progestins and the risk of breast cancer in postmenopausal women. *New England Journal of Medicine* 1995; 332(24): 1589-1639.
- 37 Col NF, Eckman MH, Karas RH, et al. Patient-specific decisions about hormone replacement therapy in postmenopausal women. *Journal of the American Medical Association* 1997; 277(14): 1140-7.
- 38 Hormonal Regimens. In: Canadian Menopause Consensus Conference. *Journal of the Society of Obstetricians and Gynecologists* 1994; 16(5): 1673-86.
- 39 *Menopause. A report by the Special Advisory Committee on Reproductive Physiology to the Drugs Directorate, Health Protection Branch.* Ottawa: Health Canada, 1995.
- 40 Jolly E. *Canada A.M.*, CTV Network, June 12, 1997.
- 41 Bromberger JT, Matthews KA, Kuller LH, et al. Prospective study of the determinants of age at menopause. *American Journal of Epidemiology*, 1997; 145(2): 124-33.
- 42 Gaudette L, Altmayer C, Nobrega K et al. Trends in mammography utilization, 1981 to 1994. *Health Reports (Statistics Canada, Catalogue 82-003-XPB)* 1996; 8(3): 17-27.
- 43 Gentleman JF, Lee J. Who doesn't get a mammogram? *Health Reports (Statistics Canada, Catalogue 82-003-XPB)* 1997; 9(1): 19-28.
- 44 Canadian Task Force on the Periodic Health Examination. *The Canadian Guide to Clinical Preventive Health Care (Health Canada, Catalogue H21-117/1994E)* Ottawa: Supply and Services Canada, 1994.

Multiple causes of death

Kathryn Wilkins, Marek Wysocki, Carole Morin and Patricia Wood

Abstract

Objectives

This article illustrates analytical uses of multiple-cause-of-death data, which reflect all causes entered on the death certificate, not only the single, underlying cause. Heart diseases are used as an example.

Data sources

Complete multiple-cause-of-death data were obtained from Newfoundland, Prince Edward Island, Nova Scotia, New Brunswick, Saskatchewan, Alberta, Yukon and the Northwest Territories; sample data were provided for Quebec and Ontario. The records represent 19% of deaths that occurred in Canada from 1990 to 1993.

Analytical techniques

The average number of causes per record, cause-specific frequencies and cause-specific ratios of mentions to selection as the underlying cause were calculated. Bivariate odds ratios were computed to study the association of selected causes of death with heart diseases.

Main results

Four-fifths of death certificates contained more than one cause; the maximum was 16. Certain causes such as septicaemia and atherosclerosis contributed to death much more often than they were selected as the underlying cause. Among selected causes, diabetes was most positively associated with the presence of heart diseases.

Key words

death certificates, mortality, comorbidity

Authors

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For statistical purposes, every death is attributed to one underlying cause, but only about one in five deaths actually results from a single cause. In the majority of cases, several conditions or diseases are involved in the death.

Classifying a death by a single, underlying cause can result in the loss of information about conditions that contributed to that death. Multiple-cause data more accurately characterize the joint or sequential occurrence of factors that may be involved.¹ Such data include all morbid conditions, diseases and injuries entered on the death certificate.

For several decades, the limitations of studying mortality statistics in terms of a single cause of death have been recognized.¹⁻³ As a result of advances in automated coding that make multiple-cause analyses feasible, several such studies have been conducted in a number of countries.⁴⁻⁹

Methods

Data source

Mortality data are collected by the provincial and territorial registries of vital statistics, which are responsible for the registration of deaths that occur in their jurisdictions. Virtually complete multiple-cause-of-death data for the Atlantic provinces, Saskatchewan, Alberta and Yukon for the early 1990s were provided to Statistics Canada. Data for the Northwest Territories cover 85% of deaths that occurred there from 1990 through 1992. Data from randomly selected samples of 3% of records were available for Quebec in 1992 and Ontario in 1993. Multiple-cause data from British Columbia and Manitoba were unavailable.

	Data years	Number of records	% of all deaths [†]
Total		151,385	19.2[‡]
Newfoundland	1990-1993	15,293	99.5 [§]
Prince Edward Island	1990-1993	4,503	98.1 [§]
Nova Scotia	1990-1993	29,986	100.0 ^{††}
New Brunswick	1990-1993	22,591	100.0 ^{††}
Quebec	1992	1,452	3.0
Ontario	1993	1,898	2.5
Saskatchewan	1990-1993	31,871	99.3 [§]
Alberta	1991-1993	42,818	96.3 [§]
Yukon	1990-1992	363	100.0
Northwest Territories	1990-1992	610	84.7 [§]

Note: Annual provincial counts of all deaths were determined from figures published in *Births and Deaths (Statistics Canada, Catalogue 84-210-XPB)*.

[†] Percentage of all deaths during period indicated

[‡] Percentage of all deaths in Canada from 1990 through 1993

[§] Coverage is under 100% because of record deletions as a result of data edits.

^{††} Records exceed published number of deaths because late registrations are included.

All causes entered on a death certificate are routinely coded, a process that produces raw multiple-cause data. The multiple-cause data are then captured and processed using ACME (Automated Coding of Medical Entities) computing software, developed by the National Center for Health Statistics (NCHS) in the United States, to confirm the underlying cause of death according to World Health Organization rules.¹⁰ ACME processing of data from Alberta and Saskatchewan was carried out by the provincial offices of vital statistics; all other data used in this article were processed at Statistics Canada.

For this analysis, the multiple-cause-of-death data were further processed using TRANSAX. TRANSAX, which also was developed by the NCHS, is software designed to eliminate redundant causes within death certificates and, where appropriate, combine pairs of codes into a third code.¹⁰⁻¹²

Based on the death registration number, province and year of occurrence for each case, the cause-of-death records were matched and merged with corresponding records from the Canadian Vital Statistics Data Base (CVSDB), maintained at Statistics Canada. For example, CVSDB information on age at death and sex was appended to each record. Further edits of the merged files deleted duplicate records and ensured consistency between cause of death, age and sex for age-related and sex-specific causes.

Analytical techniques

A total of 151,385 records were analyzed, representing 19.2% of all deaths of Canadian residents from 1990 to 1993.¹³ To assess the degree to which the records used in this analysis are representative of all Canadian deaths that occurred from 1990 to 1993, the numbers of deaths by major category of underlying cause were compared with CVSDB counts. The proportions of deaths due to malignant neoplasms, diseases of the circulatory system, respiratory diseases and external causes of injury and poisoning were similar on the two files. Thus, the exclusion of British Columbia and Manitoba did not appear to bias the results.

The number of causes on each record was tabulated, as were cause-specific frequencies. For each cause, the ratio of the number of mentions to the number of times selected as underlying cause was calculated, a standard technique in analyses of multiple-cause data.^{1,5,7,9,11,12}

Based on the International Classification of Diseases, Ninth Revision (ICD-9), 56 causes of death were selected for study (Appendix, Table A).² Some of these causes were defined as groups of ICD-9 codes and others as single three- or four-digit codes. "Diseases of the heart," for instance, includes numerous three- and four-digit codes. Thus, a record could contain more than one code belonging to a particular cause. When this was the case, each separate code was counted in calculating the average number of causes per record. But for calculations of the ratio of mentions to selections as underlying cause and of odds ratios, a cause was counted only once per record regardless of how many of its component codes appeared on that record.

To measure the bivariate association between diseases of the heart and each of the other causes of death studied, odds ratios were calculated (the odds of diseases of the heart being mentioned on a death certificate, given the mention of another specific cause, divided by the odds of diseases of the heart being mentioned on a death certificate, given that the other specific cause was not mentioned). Estimates were produced separately for each sex. To construct confidence intervals, estimates of the variance of the log odds ratios were produced.¹⁴ The odds ratios were tested using two-sided significance tests at level 0.05.

All routinely published cause-of-death information for Canada is based on a single, underlying cause.^a However, multiple-cause-of-death data for most jurisdictions have recently been provided to Statistics Canada. Previously, only limited, province-level analyses of these data have been undertaken.^{15,16} This article presents findings from all multiple-cause-of-death data that Statistics Canada has compiled (see *Methods*).

The death certificate

When someone dies, the authority (usually a physician) who certifies the death is required to record all conditions considered to have caused or contributed to it on the death certificate (see *Medical Certificate of Death*). To comply with international administrative conventions, each death is classified by identifying a single, underlying cause. The underlying cause of death is defined as: a) the disease or injury that initiated the train of events leading directly to death, or b) the circumstances of the accident or violence that produced the fatal injury.² The certifier is also expected to list the causes so that the immediate, antecedent, underlying and any contributing causes are in an order that reflects the sequence of events that caused the death.

In reality, people are often afflicted with several comorbid conditions, and death may result from a combination rather than a clear sequence of causes. Thus, it may be difficult to accurately certify the order of causes of a death. In recognition of this difficulty and to standardize the procedure of single-cause attribution when more than one condition contributes to a death, World Health Organization (WHO) rules govern the selection of the underlying cause from information entered on the death certificate.²

^a For each death due to external causes of injury and poisoning (ICD-9 codes E800-E999), an additional code or codes representing the nature of the injury or injuries resulting from the accident are certified, tabulated and published.

In this article, the term “mention” means any cause entered on the medical certificate of death—the underlying, immediate, antecedent, and contributing causes.

Medical Certificate of Death

In general, the cause entered alone on the lowest used line of Part I of the Medical Certificate of Death is selected as the underlying cause, if it reasonably could have brought about the conditions entered above it.

In the death certificate below, stroke is the underlying cause of death. Stroke caused hemiplegia (paralysis of one side of the body), which, in turn, gave rise to fatal pneumonia in a person who had diabetes. However, according to usual current practices for compiling cause-of-death information, pneumonia, hemiplegia and diabetes would not be included or even considered in published statistics. (Also, because the criteria for completing the death certificate limit the inclusion of conditions that are present but do not contribute causally to death, a person might have illnesses such as arthritis or dementia that would not be entered on the certificate.)

International Form of Medical Certificate of Cause of Death^b

Cause of Death	
I	
Disease or condition directly leading to death*	(a) <u>Pneumonia</u> due to (or as a consequence of)
Antecedent causes	(b) <u>Hemiplegia</u> due to (or as a consequence of)
Morbid conditions, if any, giving rise to the above cause, stating the underlying condition last	
	(c) <u>Stroke</u>
II	
Other significant conditions contributing to death but not related to the disease or condition causing it	{ <u>Diabetes</u>
* This does not mean the mode of dying, e.g., heart failure. It means the disease, injury or complication which caused death.	

Although the underlying cause should be entered alone on the lowest used line of Part I, frequently, several conditions are entered on this and the other lines. When the order in which causes of death have been entered on the certificate does not follow the standard, the underlying cause is derived using additional WHO rules.

^b Completed sample of the international form of medical certificate of cause of death, upon which Canadian jurisdictions model their forms.⁴

Table 1
Distribution of number of causes on death certificates, selected jurisdictions, Canada, 1990 to 1993

Number of causes mentioned	Death certificates	
	Number	%
Total	151,385	100.0
1	28,454	18.8
2	47,748	31.5
3	39,792	26.3
4	21,543	14.2
5	9,056	6.0
6	3,166	2.1
7	1,101	0.7
8-16	525	0.4

Data source: Provincial and territorial registries of vital statistics

Majority of deaths have multiple causes

Few deaths result from a single cause. On the records selected for analysis, just 19% of deaths were attributed to one cause (Table 1). The maximum number of causes entered on a death certificate was 16; the average was 2.68 (about the same as the average of 2.65 causes reported for 1991 in the United States¹²). However, given the mention of a specific cause, the average varied nearly fourfold for the 56 causes analyzed, from 1.19 for certificates containing sudden infant death syndrome (SIDS) to 4.43 for those containing accidental falls (Table 2).

Indirectly, the occurrence of multiple causes of death reflects Canadians' longevity. Two-thirds of those born in 1991 can expect to live to 75, and over a third will still be alive at 85.¹⁷ By these ages, people are typically afflicted with one or more chronic conditions.^{18,19} And although

Table 2
Average number of causes on death certificates when specific cause mentioned, selected jurisdictions, Canada, 1990 to 1993

Specific cause mentioned	Average number of causes	Specific cause mentioned	Average number of causes
Accidental falls	4.43	Alzheimer disease	2.94
Septicaemia	3.77	Homicide	2.94
Endocrine, nutritional and metabolic diseases and immunity disorders	3.77	Malignant neoplasm of bladder	2.90
Diseases of the genitourinary system	3.73	Malignant neoplasm of prostate	2.86
Diabetes mellitus	3.70	Conditions originating in perinatal period	2.84
Tuberculosis	3.68	Accidents caused by fire and flames	2.82
Nephritis, nephrotic syndrome and nephrosis	3.67	Aortic aneurysm	2.75
Infectious and parasitic diseases	3.58	Malignant neoplasm of kidney	2.75
Diseases of the digestive system	3.56	Malignant neoplasm of uterus and cervix	2.75
External causes of injury and poisoning	3.53	All causes	2.68
Atherosclerosis	3.52	Malignant neoplasm of small intestine, colon, rectum	2.65
Mental disorders	3.48	Malignant neoplasm of female breast	2.64
Chronic airways obstruction, not elsewhere classified	3.46	Suicide	2.62
Parkinson disease	3.38	Leukemia	2.57
Nervous system diseases	3.35	Malignant neoplasm of lip, oral cavity and pharynx	2.57
Senile and presenile organic psychotic conditions	3.32	Malignant neoplasms	2.49
Respiratory diseases	3.30	Accidental drowning and submersion	2.46
Asthma	3.29	Malignant neoplasm of esophagus	2.45
Ill-defined and unknown causes	3.29	Malignant neoplasm of lymphatic tissue	2.42
Chronic liver disease and cirrhosis	3.28	Malignant neoplasm of liver and bile ducts	2.42
Bronchitis, emphysema, asthma	3.26	Malignant neoplasm of stomach	2.41
Pneumonia and influenza	3.17	Malignant melanoma of skin	2.39
Motor vehicle traffic accidents	3.13	Malignant neoplasm of ovary, other uterine adnexa	2.38
Congenital anomalies	3.12	Malignant neoplasm of trachea, bronchus and lung	2.34
Cerebrovascular diseases	3.04	Malignant neoplasm of pancreas	2.27
Diseases of the heart	3.03	HIV/AIDS	2.03
Ischaemic heart disease	3.02	Malignant neoplasm of brain	1.89
Hypertensive heart disease	2.98	Sudden infant death syndrome (SIDS)	1.19
Diseases of the circulatory system	2.96		

Data source: Provincial and territorial registries of vital statistics

Note: All codes appearing on death records were counted for calculations of average number of causes per record.

death certificates do not completely reflect the prevalence of disease before death, the average number of causes tends to increase with age (Chart 1). In fact, over half the deaths of people aged 65 or over were attributed to three or more causes (Chart 2).

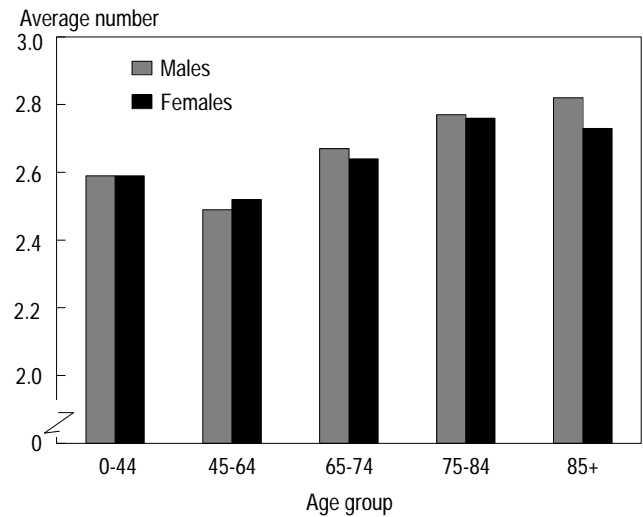
The average number of causes entered on death certificates of both males and females was higher at ages 0-44 than at ages 45-64. This reflects the substantial proportion of deaths in the younger age range that result from external causes such as motor vehicle accidents, which usually entail multiple injuries.²⁰

Always a bridesmaid . . .

Certain causes contributed to death much more often than they were selected as the underlying cause. "Ill-defined and unknown causes" had the highest ratio of mentions to selections as the underlying cause. At least one condition from the ill-defined and unknown causes group was mentioned on almost 22,000 (14%) death certificates, but selected as the underlying cause on just 1,097 of them. Thus, it was mentioned 20 times as often as it was selected as the underlying cause (Table 3). This would be expected since WHO rules preclude the selection

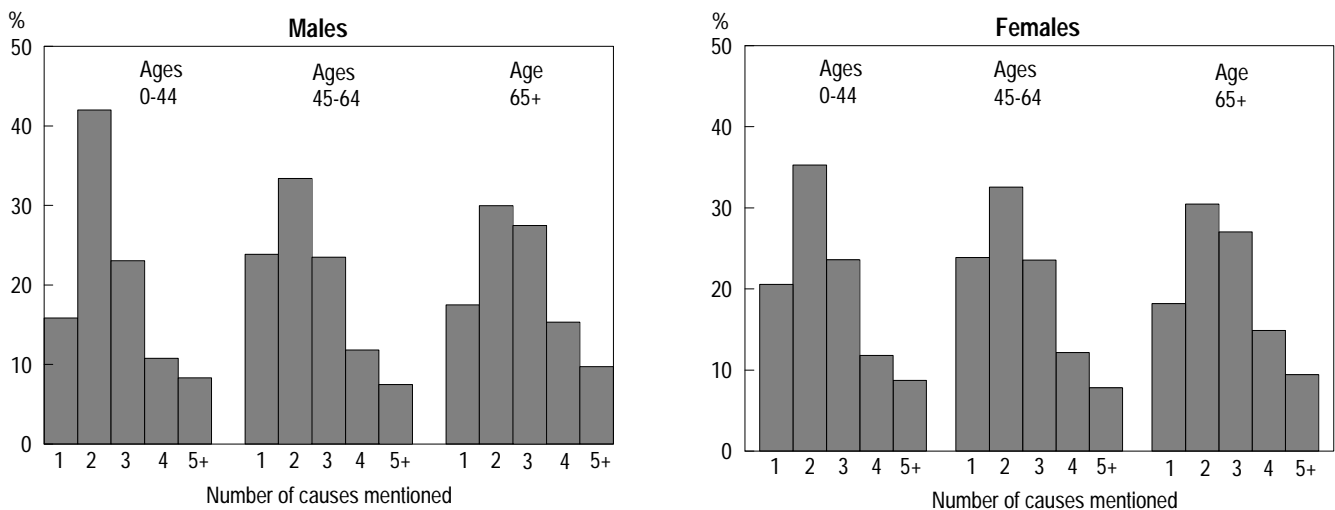
of ill-defined or unknown causes as the underlying cause when another condition that does not lie within these coding ranges is mentioned on the death certificate.²

Chart 1
Average number of causes on death certificates, by sex and age group of deceased, selected jurisdictions, Canada, 1990 to 1993



Data source: Provincial and territorial registries of vital statistics

Chart 2
Percentage distribution of number of causes on death certificates, by sex and age group of deceased, selected jurisdictions, Canada, 1990 to 1993



Data source: Provincial and territorial registries of vital statistics

Septicaemia and atherosclerosis also had high ratios of mentions to selections as the underlying cause: both were mentioned on death certificates about five times as often as they were specified as the underlying cause. Other causes with high ratios included nephritis, nephrotic syndrome and nephrosis; diseases of the genitourinary system; mental disorders; and diabetes mellitus (Chart 3). The average ages at death for the causes with the highest ratios were relatively advanced, ranging from 73 to 81.

These results are similar to findings reported in the United States and Spain.^{1,5} The high ratios for these conditions reflect the frequency with which they are included in, but do not initiate, the sequence of causes that lead to death.

Table 3
Causes of death with highest and lowest ratios of mentions to selections as underlying cause, selected jurisdictions, Canada, 1990 to 1993

Cause of death	Death certificates with any mention†	Selected as underlying cause	Ratio of mentions to underlying cause	Average age at death (when cause mentioned)
Highest ratios				
Ill-defined and unknown causes	21,919	1,097	19.98	75.7
Septicaemia	3,661	644	5.68	72.5
Atherosclerosis	7,364	1,354	4.86	80.8
Nephritis, nephrotic syndrome, nephrosis	8,958	1,936	4.63	75.7
Diseases of genitourinary system	10,999	2,640	4.17	76.3
Mental disorders	10,411	2,536	4.11	74.5
Diabetes mellitus	11,677	3,269	3.57	75.4
Lowest ratios				
Suicide	2,989	2,977	1.00	39.5
Homicide	468	465	1.01	34.3
Motor vehicle traffic accidents	3,292	3,238	1.02	38.1
Accidents caused by fire and flames	369	358	1.03	38.1
Malignant neoplasm of pancreas	2,228	2,117	1.05	71.6
Malignant neoplasm of brain	997	929	1.07	58.0
HIV/AIDS	455	423	1.08	38.2

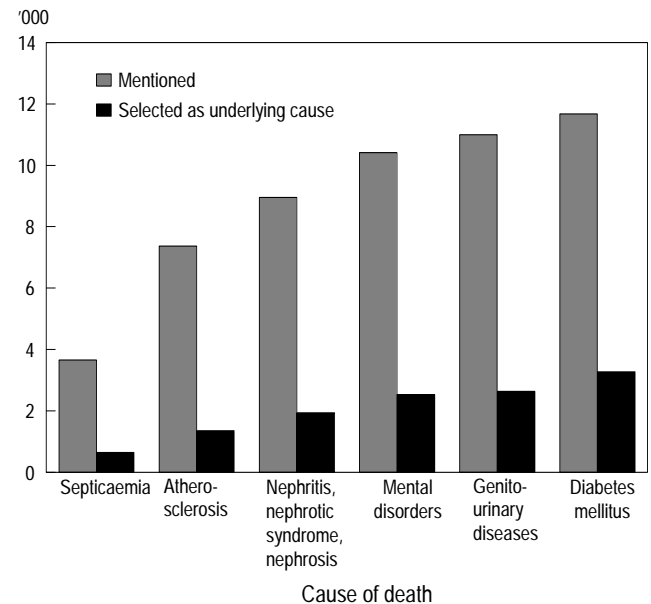
Data source: Provincial and territorial registries of vital statistics
Note: When more than one code from a coding range defined as a cause of death (Appendix, Table A) appeared on a record, the code was counted only once for calculations of mentions-to-underlying-cause ratios.
 † Includes death certificates with age unknown.

Usually underlying causes

Other causes of death almost invariably appeared on death certificates as the underlying cause, so their ratios of mentions to selections as the underlying cause were approximately 1.00. Suicide, motor vehicle traffic accidents, homicide, accidents due to fire and flames, and HIV/AIDS were usually listed as underlying causes. The average ages at death from these causes were comparatively young (from age 34 to 40).

As well, two types of cancer—malignant neoplasms of the pancreas and the brain—were typically listed on the death certificate as the underlying cause, likely because of their lethality and relatively short survival time. The average age at death was 72 for pancreatic cancer and 58 for brain cancer, notably older than for the other, mostly trauma-related causes with low ratios of mentions to selections as the underlying cause.

Chart 3
Frequency of mention and specification as underlying cause on death certificates, selected causes of death, selected jurisdictions, Canada 1990 to 1993



Data source: Provincial and territorial registries of vital statistics

Rarely alone

Some underlying causes of death were rarely entered alone on the death certificate (Table 4). This applied to most external causes, which were routinely accompanied by at least one entry related to the injuries resulting from the external cause.

Death certificates with accidental falls as the underlying cause had, by far, the highest average number of causes (4.12). To some extent, this is because the average age of those who died in accidental falls was 78, and other conditions are typically present in the elderly.²⁰

Death certificates with motor vehicle traffic accident, homicide, or accident caused by fire and flames selected as the underlying cause also had higher-than-average numbers of causes. These external causes of death are more likely to involve multiple injuries than are suicides and drownings, for which the average number of causes was comparatively low.

Table 4
Underlying causes rarely reported alone on death certificates, selected jurisdictions, Canada, 1990 to 1993

Underlying cause (UDLC)†	Number of deaths‡	Deaths for which UDLC is only cause %	Average number of causes per death	Average age at death Years
Accidental falls	1,360	0	4.12	77.70
Accidental drowning and submersion	466	0	2.41	34.78
Motor vehicle accidents	3,238	0.12	3.11	37.68
Homicide	465	0.43	2.94	34.19
Suicide	2,977	0.64	2.62	39.46
Accidents caused by fire and flames	358	0.84	2.78	37.31
Diabetes mellitus	3,269	2.32	3.32	75.16
Tuberculosis	149	6.71	3.20	71.48
Chronic airways obstruction, n.e.c.	4,599	7.33	2.98	77.67
Septicaemia	644	8.07	3.28	73.94

Data source: Provincial and territorial registries of vital statistics

Note: All codes on death records were counted for calculations of average number of causes per record.

† ICD-9 codes at three-digit level, not ranges of codes

‡ Includes age unknown.

n.e.c. Not elsewhere classified

The non-external underlying causes least likely to occur alone on death certificates included diabetes mellitus, for which the average number of causes was 3.32, septicaemia (3.28 causes), tuberculosis (3.20), and chronic airways obstruction, not elsewhere classified (2.98). The high averages are a consequence of the complex of health problems that often attend these conditions, since the average ages at death when these diseases were the underlying cause were fairly advanced, ranging from 71 to 78.

Most often alone

By contrast, other causes were usually reported alone on death certificates. This was most frequently the case with SIDS: 98% of deaths for which SIDS was the underlying cause were attributed to SIDS only (Table 5). The ICD-9 code for SIDS is in the ill-defined and unknown

Table 5
Underlying causes frequently reported alone on death certificates, selected jurisdictions, Canada, 1990 to 1993

Underlying cause (UDLC)†	Number of deaths‡	Deaths for which UDLC is only cause %	Average number of causes per death	Average age at death Years
Sudden infant death syndrome	339	98.2	1.02	0.01
Malignant neoplasm of brain	929	50.3	1.79	57.8
HIV/AIDS	423	44.9	1.91	38.0
Malignant neoplasm of pancreas	2,117	35.5	2.19	71.3
Malignant neoplasm of lymphatic tissue	2,193	34.4	2.22	68.1
Malignant melanoma of skin	387	33.9	2.21	61.1
Malignant neoplasm of stomach	1,697	31.8	2.28	71.7
Aortic aneurysm	1,578	31.3	2.35	75.4
Malignant neoplasm of liver and bile ducts	625	30.9	2.29	69.6
Malignant neoplasm of ovary, other uterine adnexa	852	30.4	2.28	66.6

Data source: Provincial and territorial registries of vital statistics

Note: All codes on death records were counted for calculations of average number of causes per record.

† ICD-9 codes at three-digit level, not ranges of codes

‡ Includes age unknown.

The case of heart diseases

Multiple-cause-of-death data show that some causes frequently appear together.²¹ This is illustrated in the case of heart diseases, which were chosen for analysis because of their importance not only as an underlying cause of death, but also as an associated cause.

Diseases of the heart led all other causes, being mentioned on 68,729 (45%) of the 151,385 death certificates analyzed, but selected as the underlying cause on just 29% of them. However, relatively few statistically significant positive associations between mentions of heart diseases and mentions of other causes were found (Appendix, Table B). For males, only 6 of 37 odds ratios were significantly different from and above 1.0, while 30 were significantly different from and lower than 1.0, and one was not significant. Similarly for females, 7 of 39 odds ratios were significant and above 1.0; 30 were significant and below 1.0; and two were not significant.

For both sexes the highest odds ratio was for diabetes mellitus. The odds of diseases of the heart occurring on a death certificate that contained a mention of diabetes were over two and a half times as great as for certificates that did not mention diabetes. The risk of heart disease is known to be elevated in people with diabetes, and the physiological basis of the link between these diseases is well documented in the medical literature. As well, diabetes is a common precursor of atherosclerotic coronary disease manifested by angina or myocardial infarction.²² Not surprisingly then, mentions of atherosclerosis were also positively associated with mentions of diseases of the heart.

Positive associations occurred between diseases of the heart and several respiratory diseases, including chronic airways obstruction (not elsewhere classified) and bronchitis, emphysema and asthma. The associations between these diseases and diseases of the heart on the death certificate may reflect exposure to tobacco smoking, which is a risk factor for both heart disease and chronic obstructive respiratory diseases.

Nephritis, nephrotic syndrome and nephrosis were positively associated with mentions of diseases of the heart. This was expected, in view of the common occurrence of cardiovascular complications such as hypertension in people with renal failure.

Mentions of SIDS and of most external causes of death (drowning, accidents caused by fire and flames, homicide, motor vehicle traffic accidents, and suicide) showed the strongest negative associations with diseases of the heart. This is not surprising, given the young average ages at death and the acute nature of SIDS and these external causes.

Generally, the magnitudes of the odds ratios and the causes of death that were positively and negatively associated with diseases of the heart were similar for males and females. An exception was accidental falls, which was positively associated with diseases of the heart among females but negatively associated among males. The positive association reflects the typical comorbidity among elderly women who are at greatest risk of sustaining an accidental fall that leads or contributes to death.

causes group,^c and as such, according to WHO coding rules, is not to be selected as the underlying cause when any other condition (that is not also an ill-defined condition) is on the death certificate.² Therefore, when SIDS was designated the underlying cause of death, it was typically the only cause. An average of 1.02 causes were listed on death certificates with SIDS as the underlying cause.

Malignant neoplasm of the brain and HIV/AIDS ranked second and third, in terms of the frequency with which they were reported alone as underlying causes of death. When designated the underlying cause, malignant neoplasm of the brain was reported alone 50% of the time, and these death certificates averaged 1.79 causes. HIV/AIDS was reported alone 45% of the time and averaged 1.91 causes.

The average number of causes on death certificates with any malignant neoplasm as the underlying cause was usually low. (The exceptions were cancer of the uterus and cervix, kidney, prostate and bladder.) This reflects the ultimately fatal course of many cancers. It also suggests a generally lower prevalence of comorbid conditions among people dying from cancer, compared with other causes, and corroborates the findings of a recent multiple-cause study in the Netherlands.⁷

Implications for future research

The use of single-cause mortality data bases tends to obscure the contribution of causes that are entered on the death certificate but are infrequently selected as the underlying cause. With multiple-cause data, it is possible to assess the importance of these nonunderlying causes. Such data represent more completely, and thus more accurately, the complicated and sometimes synergistic causal circumstances of death (see *The case of heart diseases*). Multiple-cause data provide an opportunity to study the complexity of morbid conditions that are involved in death and

^cFor this analysis, SIDS was examined separately and is shown as a separate entry in Appendix Table A.

the contribution of these conditions to mortality rates.

From a public health policy perspective, multiple-cause data are valuable for revealing disorders that are relatively infrequent selections as the underlying cause of death, but which contribute to frailty, and ultimately, to the risk of dying. Because a death may result from a certain combination of conditions rather than a single cause, it may be possible to delay it by intervening in one or more of the nonunderlying causes.²¹

In Canada, the implementation of technological enhancements to the means by which death data are processed will soon make more multiple-cause-of-death data available. The analytical potential of the data is great, both for those interested in exploring associations between conditions leading to death and those seeking a more complete representation of the causes of death.

References

- 1 Israel RA, Rosenberg HM, Curtin L. Analytical potential for multiple cause-of-death data. *American Journal of Epidemiology* 1986; 124(2): 161-79.
- 2 World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death, 9th Revision*, Vol. 1. Geneva: World Health Organization, 1977.
- 3 Dorn HF, Moryama IM. Uses and significance of multiple cause tabulations for mortality statistics. *American Journal of Public Health* 1964; 54: 400-6.
- 4 Newens AJ, Forster DP, Kay DWK. Death certification after a diagnosis of presenile dementia. *Journal of Epidemiology and Community Health* 1993; 47: 293-7.
- 5 Tardon AG, Zaplana J, Hernandez R, et al. Usefulness of the codification of multiple causes of death in mortality statistics. *International Journal of Epidemiology* 1995; 25(5): 1132-7.
- 6 Lindahl BIB, Johansson LA. Multiple cause-of-death data as a tool for detecting artificial trends in the underlying cause statistics: a methodological study. *Scandinavian Journal of Social Medicine* 1994; 2: 145-58.
- 7 Mackenbach JP, Kunst AE, Lautenbach H, et al. Competing causes of death: An analysis using multiple-cause-of-death data from The Netherlands. *American Journal of Epidemiology* 1995; 141(5): 466-75.
- 8 Coste J, Jouglu E. Mortality from rheumatoid arthritis in France, 1970-1990. *International Journal of Epidemiology* 1994; 23(3): 545-52.
- 9 Bradshaw BS, Blanchard S, Thompson GH. Emergence of diabetes mellitus in a Mexican-origin population: A multiple cause-of-death analysis. *Social Biology* 1995; 42(1-2): 36-49.
- 10 National Center for Health Statistics. *Computer installation instructions for the "Medical Index, Classification, and Retrieval" (MICAR) and "Automatic Classification of Medical Entities" (ACME ICD-9) and "Translation of Axis" (TRANSAX ICD-9)*. Division of Vital Statistics, Technical Services Branch, Research Triangle Park, North Carolina, 1992.
- 11 Chamblee RF, Evans MC. TRANSAX: The NCHS system for producing multiple-cause-of-death statistics, 1968-78. *Vital and Health Statistics* (Public Health Service, Series 1, no. 20) Washington, D.C.: U.S. Government Printing Office, 1986.
- 12 Kochanek KD, Rosenberg HM. Issues, considerations and examples in the use of multiple causes of death in United States Government statistics. Presented to the *World Health Organization Heads of Collaborating Centres Ad Hoc Meeting on Multiple Cause Analyses*, London, April, 1994.
- 13 Statistics Canada. *Births and Deaths, 1995* (Catalogue 84-210-XPB) Ottawa: Minister of Industry, 1996.
- 14 Agresti A. *Categorical data analysis*. New York: John Wiley and Sons, 1990.
- 15 Macdonald JM, Tuk TA, Cranfield C. *Cancer mortality in British Columbia 1988-1992: Patterns of underlying cause and multiple cause data*. Victoria: Division of Vital Statistics, British Columbia Ministry of Health and Ministry Responsible for Seniors, 1993.
- 16 Tuk TA, Macdonald J. *Drug-related deaths in British Columbia: 1981 to 1993*. Victoria: Division of Vital Statistics, British Columbia Ministry of Health and Ministry Responsible for Seniors, 1994.
- 17 Statistics Canada. *Life tables, Canada and the provinces, 1990-1992* (Catalogue 84-537) Ottawa: Minister of Industry, 1995.
- 18 Hoffman C, Rice D, Sung H-Y. Persons with chronic conditions—Their prevalence and costs. *Journal of the American Medical Association* 1996; 276(18): 1473-9.
- 19 Wilkins K, Park E. Chronic conditions, physical limitations and dependency among seniors living in the community. *Health Reports* (Statistics Canada, Catalogue 82-003-XPB) 1996; 8(3): 7-15.
- 20 Wilkins K. Causes of death: How the sexes differ. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(2): 33-43.
- 21 Manton KG, Stallard E, Poss SS. Estimates of U.S. multiple cause life tables. *Demography* 1980; 17(1): 85-102.
- 22 Berkow R, Fletcher AJ (editors). *The Merck manual of diagnosis and therapy*. Rahway, New Jersey: Merck Research Laboratories, 1992.

Appendix

Table A

Causes of death selected for study

Cause of death	ICD-9 code	Cause of death	ICD-9 code
All causes	001-999	Diseases of the circulatory system	390-459
Infectious and parasitic diseases	001-139	Diseases of the heart	391, 392.0, 393-398, 402, 404, 410-416, 420-429
Tuberculosis	010-018, 137	Hypertensive heart disease	402, 404
Septicaemia	038	Ischaemic heart disease	410-414
HIV/AIDS	042-044	Cerebrovascular disease	430-438
Malignant neoplasms	140-208	Atherosclerosis	440
Malignant neoplasm of lip, oral cavity and pharynx	140-149	Aortic aneurysm	441
Malignant neoplasm of esophagus	150	Respiratory diseases	460-519
Malignant neoplasm of stomach	151	Pneumonia and influenza	480-487
Malignant neoplasm of small intestine, colon and rectum	152-154	Bronchitis, emphysema, asthma	490-493
Malignant neoplasm of liver and bile ducts	155	Asthma	493
Malignant neoplasm of pancreas	157	Chronic airways obstruction, not elsewhere classified	496
Malignant neoplasm of trachea, bronchus and lung	162	Diseases of the digestive system	520-579
Malignant melanoma of skin	172	Chronic liver disease and cirrhosis	571
Malignant neoplasm of female breast	174	Diseases of the genitourinary system	580-629
Malignant neoplasm of uterus and cervix	179-182	Nephritis, nephrotic syndrome and nephrosis	580-589
Malignant neoplasm of ovary, other uterine adnexa	183	Congenital anomalies	740-759
Malignant neoplasm of prostate	185	Conditions originating in perinatal period	760-779
Malignant neoplasm of bladder	188	Ill-defined and unknown causes	797-799 except 798.0
Malignant neoplasm of kidney	189.0-189.2	Sudden infant death syndrome	798.0
Malignant neoplasm of brain	191	External causes of injury and poisoning	E800-E999
Malignant neoplasm of lymphatic tissue	200-203	Motor vehicle accidents	E810-E825, E929.0
Leukemia	204-208	Accidental falls	E833-E835, E880-E888
Endocrine, nutritional and metabolic diseases and immunity disorders	240-279	Accidents caused by fire and flames	E890-E899
Diabetes mellitus	250	Accidental drowning and submersion including watercraft, water transport accidents	E830, E832, E910
Mental disorders	290-319	Suicide	E950-E959
Senile and presenile organic psychotic conditions	290	Homicide	E960-E969
Diseases of the nervous system and sense organs	320-389		
Alzheimer's disease	331.0		
Parkinson's disease	332		

Source: World Health Organization (reference 2)

Table B

Odds ratios for mention of selected causes when diseases of the heart was mentioned on death certificates, by sex, selected jurisdictions, Canada, 1990 to 1993

Other cause mentioned on death certificate	Males		Females	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Diabetes mellitus	2.70	2.55, 2.86	2.57	2.43, 2.72
Atherosclerosis	2.26	2.11, 2.42	1.56	1.46, 1.67
Chronic airways obstruction, not elsewhere classified	1.61	1.53, 1.69	1.57	1.46, 1.68
Asthma	1.59	1.31, 1.93	1.45	1.21, 1.74
Nephritis, nephrotic syndrome and nephrosis	1.37	1.30, 1.45	1.41	1.33, 1.51
Bronchitis, emphysema, asthma	1.16	1.06, 1.26	1.23	1.10, 1.38
Tuberculosis	.90	.68, 1.19	.96	.69, 1.33
Parkinson's disease	.83	.73, .94	.84	.73, .97
Accidental falls	.80	.72, .89	1.19	1.08, 1.32
Aortic aneurysm	.79	.71, .89	.91	.78, 1.06
Senile and presenile organic psychotic conditions	.78	.70, .88	.77	.70, .85
Cerebrovascular disease	.77	.73, .80	.68	.65, .71
Alzheimer's disease	.68	.61, .75	.61	.55, .66
Pneumonia and influenza	.55	.52, .57	.58	.55, .60
Malignant neoplasm of prostate	.47	.44, .50	...	...
Septicaemia	.47	.42, .52	.53	.48, .59
Chronic liver disease and cirrhosis	.44	.39, .50	.39	.33, .46
Malignant neoplasm of bladder	.44	.38, .51	.39	.30, .50
Malignant neoplasm of kidney	.36	.30, .42	.30	.24, .38
Leukemia	.34	.29, .40	.38	.32, .45
Malignant neoplasm of lymphatic tissue	.33	.29, .37	.32	.28, .36
Malignant neoplasm of uterus and cervix	...	...	.30	.26, .36
Malignant neoplasm of small intestine, colon, rectum	.30	.28, .34	.26	.24, .29
Malignant neoplasm of lip, oral cavity and pharynx	.29	.23, .36	.23	.16, .34
Malignant neoplasm of stomach	.29	.25, .33	.28	.24, .34
Malignant neoplasm of female breast	...	...	.28	.26, .31
Malignant melanoma of skin	.27	.20, .37	.30	.20, .44
Malignant neoplasm of esophagus	.25	.21, .31	.19	.13, .28
Malignant neoplasm of trachea, bronchus and lung	.25	.24, .27	.21	.19, .23
Malignant neoplasm of liver and bile ducts	.24	.19, .31	.23	.16, .32
Malignant neoplasm of ovary, other uterine adnexa	...	...	.23	.19, .27
Malignant neoplasm of pancreas	.21	.18, .25	.21	.18, .25
Malignant neoplasm of brain	.12	.09, .16	.17	.13, .23
HIV/AIDS	.10	.07, .14	.17	.05, .57
Accidents caused by fire and flames	.09	.06, .15	.05	.02, .13
Accidental drowning and submersion	.07	.04, .10	.09	.03, .24
Motor vehicle traffic accidents	.06	.05, .07	.06	.05, .08
Homicide	.05	.03, .09	.03	.01, .07
Suicide	.03	.03, .04	.03	.02, .06
Sudden infant death syndrome	.02	.01, .05	.01	.00, .05

Data source: Provincial and territorial registries of vital statistics

Note: In cases when more than one code from a group of codes defining a cause of death appeared on a record (Appendix, Table A), the code was counted only once.
... Not applicable

Factors associated with bicycle helmet use

Wayne J. Millar and Ivan B. Pless

Abstract

Objectives

This article examines characteristics associated with the use of bicycles and bicycle helmets by children and adults.

Data sources

The data on bicycle use and bicycle helmet use are from a Health Canada-sponsored supplement to Statistics Canada's 1994/95 National Population Health Survey. Mortality data are from the Canadian Vital Statistics Data Base, maintained by Statistics Canada.

Analytical techniques

Rates of bicycle use and of bicycle helmet use by children and adults were calculated.

Main results

The majority (58%) of parents of children aged 12 and younger reported that their children always wear helmets when riding a bicycle. Low rates of helmet use among children in lower-income households may be attributable to the cost of helmets and to differences in the perception of the consequences of injuries. Only a minority of teenage and adult cyclists were helmet users. The leading reason for not wearing a helmet was not owning one, followed by discomfort. Helmet use tended to be higher in provinces with legislation requiring it.

Conclusion

Although bicycle helmets have proven effective in reducing injury and death, relatively few Canadian cyclists wear them, and few provinces have helmet laws.

Key words

head protective devices, head injuries, athletic injuries

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Harsh winters and a level of affluence that puts motor vehicles within the reach of most people probably militate against bicycles ever becoming the indispensable mode of transportation in Canada that they are in many other parts of the world. Nonetheless, millions of Canadians ride bicycles for pleasure, for commuting, and for exercise.¹

But cycling is not without risk. In 1993, more than 10,000 cyclists were injured in traffic collisions.² Bicycle-associated injuries can cause death or result in a disability.³ The most serious injuries and the majority of bicycle-related deaths result from head injuries. Several studies have demonstrated that such injuries can be prevented, or their severity greatly reduced, through the use of an approved, properly fitted and properly worn bicycle helmet.⁴⁻⁷ Yet in 1994/95, about four in ten children and the majority of teenagers and adults who rode bicycles did not always wear a helmet.

This article uses data from the 1994/95 National Population Health Survey (NPHS) to examine the use of bicycles and bicycle helmets by Canadians (see *Methods* and *Limitations*). It also explores attitudes toward helmet use and the status of helmet legislation.

Methods

Data sources

The data in this article are from the household component of the National Population Health Survey (NPHS), conducted by Statistics Canada from June 1994 through June 1995. A detailed description of the survey design, sample, and interview procedures has been published.^{8,9}

Data on the use of bicycles and bicycle helmets are based on a Health Canada-sponsored supplement to the NPHS. The sample size of this supplement was 13,400. The response rate for the supplement was 90.6%.

In households with children aged 12 and younger, a parent answered questions about the children's use of bicycles and of bicycle helmets. Parents were asked: "Does ... ride a bicycle (including tricycles)?" For each child who rode a bicycle or tricycle, parents were asked: "When riding a bicycle how often does ... wear a helmet?" Response options were: *always, most of the time, rarely, never*. For this article, only those who reported "always" were considered to be **helmet users**. This is consistent with a recent report that suggests that restricting the definition of helmet use to those who always wear a helmet may better emulate community studies in which cyclists are actually observed on the roads.¹⁰

An additional question asked, "What is the main reason ... doesn't wear a helmet all the time?" Response options were: *don't have one; aren't effective; aren't necessary/don't need one; costs too much; uncomfortable to wear helmet/helmet doesn't fit/don't like them; would be laughed at/would be silly; only ride in safe areas; interferes with riding; friends don't wear them; inconvenient/difficult to store; any other reason*. Interviewers were instructed to record only the first-mentioned response.

Respondents aged 12 and older were asked if they had cycled in the past three months as a leisure time activity. In addition, they were asked, "In a typical week [in the last three months], how much time did you usually spend bicycling to work or to school or while doing errands." Response options ranged from none to more than 20 hours. Respondents who had cycled in the last three months during leisure or non-leisure time were defined as **cyclists**. They were asked: "When riding a bicycle how often did you wear a helmet?" Those who did not wear a helmet all the time were asked the main reason for not doing so. Response options were: *don't have one; aren't effective; aren't necessary/don't need one; costs too much; uncomfortable to wear helmet/helmet doesn't fit/don't like them; would be laughed at/would be silly; only ride in safe areas; interferes with riding; friends don't wear them; inconvenient/difficult to store; any other reason*. Interviewers recorded only the first-stated response.

Parents of children aged 12 and younger were asked their perception of the relative importance of five causes of death in childhood: "I am going to read five health problems which can cause

death in young children after the first birthday. Please tell me which one you think is the leading cause of death." Response options were: *cancer, injuries, cystic fibrosis, meningitis, heart disease*.

Data on deaths from bicycle-related accidents are from the Canadian Vital Statistics Data Base, managed by the Health Statistics Division of Statistics Canada. For each external cause of death associated with bicycle use,^a the nature of the injury that led to death is recorded and coded according to the Ninth Revision of the International Classification of Diseases (ICD-9).¹¹ The ICD-9 codes examined for this article were:

E810-E819 - motor vehicle traffic accidents (with .6 appended to identify injured person as a pedal cyclist)

E820-E825 - motor vehicle non-traffic accidents (with .6 appended)

E826 - pedal cycle accident

Analytical techniques

Age-specific rates of use of bicycles and helmets were analyzed to determine if there were differences by sex, region, and level of income.

All estimates were weighted to represent the Canadian population at the date of the survey. The total 1994/95 population of Canada aged 12 and older was used as the reference population for direct standardization of rates.

Estimates of helmet use by children aged 12 and younger are based on information provided by a parent. If more than one child lived in the household, the parent reported on each child separately. The analysis in this article concerns only one child in each household. Sampling weights apply to the parent rather than to the child. Consequently, the weighted estimates do not equal the population of children.

As well as being among the children for whom parents responded, 12-year-olds could also have been selected as respondents in the complete survey, so they are included in the analysis of the adult population (aged 12 and older).

Households were grouped into five categories based on the number of members and their combined annual income: lowest, lower-middle, middle, upper-middle and highest. In cases where the count for a lower-middle or middle income category would lead to imprecise estimates, the household income categories were combined into four levels: lowest, lower-middle/middle, upper-middle and highest.

^a According to ICD-9, a pedal cycle is any road transport vehicle operated solely by pedals and includes bicycle, pedal cycle, or tricycle. A pedal cyclist is defined as any person riding on a pedal cycle or in a side car attached to such a vehicle.¹¹

Most kids ride bikes/wear helmets

Most children ride bicycles or tricycles. In 1994/95, 62% of parents with a child aged 12 and younger reported that their child rode a bicycle or tricycle. The percentage ranged from 59% in Quebec to 66% in British Columbia (Table 1). Rural or urban residence had little relationship to bicycle or tricycle use, but differences by household income were notable.

Children's use of bicycle helmets differed depending on where they lived. Nationally, 58% of parents reported that their child who rode a bicycle or tricycle always wore a helmet, but the figure varied from 44% in the Prairies to 65% in Ontario and British Columbia. To some extent, Ontario's high

rate may reflect laws mandating the use of helmets in that province. British Columbia has helmet legislation, but it was enacted in 1996, after the NPHS was conducted (see *Bicycle helmet legislation*). However, the impending legislation in British Columbia may have reflected public sentiment and practice.

Helmet use was relatively low in rural areas. Whereas 59% of parents in urban communities reported that their child always wore a helmet, the figure was 34% in rural areas.

Differences in helmet use by household income were also striking. Of children in the highest income households, 69% wore helmets, compared with 50% or less in the two lowest income groups. One reason for these low rates may be differences in the perception of the danger of injuries during childhood. Although injuries are the leading cause of death among children, only 42% of parents in the lowest household income group knew this, compared with 62% in the middle and 82% in the highest income groups (Chart 1).

Table 1
Bicycle use and helmet use, children aged 12 and younger, by region, rural/urban residence, and household income, Canada, 1994/95

	Parents of child aged 12 and younger†	Parents whose child used bicycle/tricycle	Bicycle/tricycle use rate	Parents whose child always wore helmet	Helmet use rate
	'000	'000	%	'000	% of bicycle/tricycle users
Total	5,883	3,619	62	2,084	58
Region‡					
Atlantic	463	288	62	168	58
Quebec	1,441	844	59	428	51
Ontario	2,267	1,405	62	912	65
Prairies	990	607	61	268	44
British Columbia	723	474	66	309	65
Rural/Urban§					
Rural	799	518	65	177	34
Urban	2,793	1,684	60	990	59
Household income¶¶					
Lowest	235	119	51	60	50
Lower-middle	819	470	57	204	43
Middle	1,799	1,119	62	602	54
Upper-middle	2,036	1,242	61	786	63
Highest	801	534	67	368	69

Data source: National Population Health Survey, 1994/95

Note: Based on the first-mentioned child only.

† Based on information provided by parents of children aged 12 and younger; does not reflect the population aged 12 and younger.

‡ Because of rounding, detail may not sum to total.

§ Rural/urban does not sum to total because of a category added to ensure confidentiality.

¶¶ Income does not sum to total because of not stated category which is not shown.

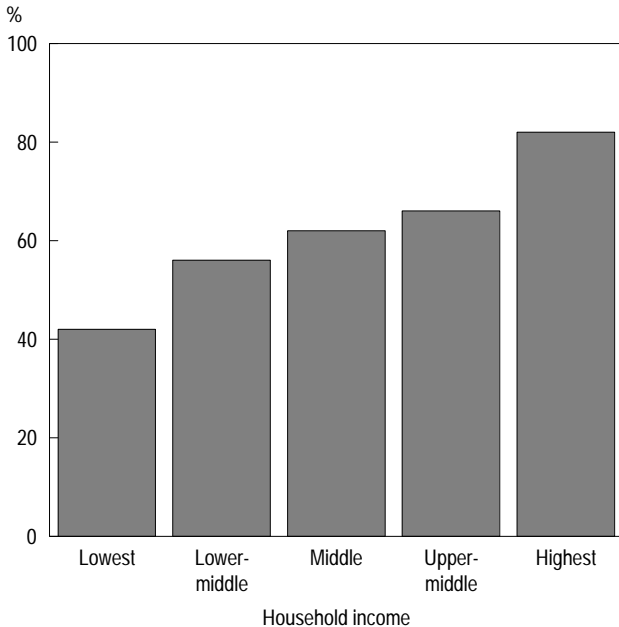
Bicycle helmet legislation

Currently, helmet legislation affects only a small proportion of Canadian cyclists, and the focus has tended to be on children. Manitoba's legislation, for instance, applies to children under age 6 riding in bicycle carriers. Ontario introduced legislation making bicycle helmet use mandatory for cyclists younger than age 18. However, British Columbia's legislation covers cyclists of all ages. In 1996, Nova Scotia gave first reading to a bill that would make bicycle helmet use mandatory. Although most provinces lack legislation, individual municipalities may have laws requiring helmet use.

Provincial bicycle helmet legislation, Canada, 1996

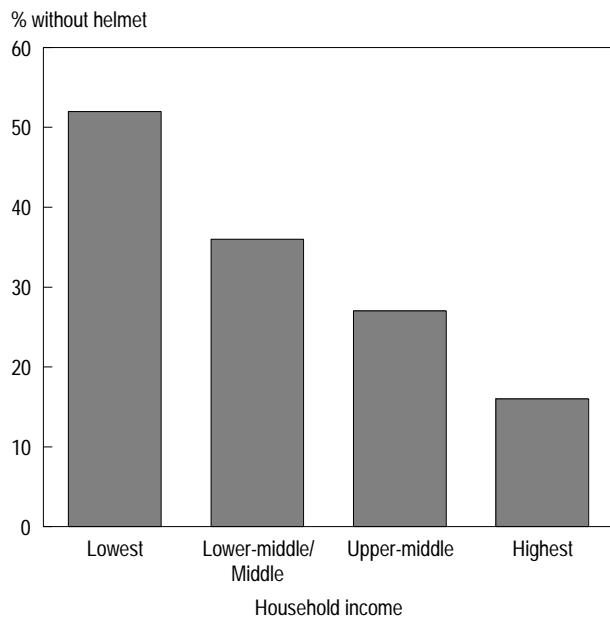
Newfoundland	No provincial legislation
Prince Edward Island	No provincial legislation
Nova Scotia	First reading passed; all ages
New Brunswick	No provincial legislation
Quebec	No provincial legislation
Ontario	Law introduced October 1995; persons younger than 18
Manitoba	Children younger than 6 in rear bicycle carriers
Saskatchewan	No provincial legislation
Alberta	No provincial legislation
British Columbia	Law introduced September 1996; all ages

Chart 1
Percentage of parents reporting injury as leading cause of death of children, by household income, Canada, 1994/95



Data source: National Population Health Survey, 1994/95

Chart 2
Percentage of parents reporting their cyclist child did not wear bicycle helmet because he/she did not have one, by household income, Canada, 1994/95



Data source: National Population Health Survey, 1994/95
 Note: Based on first-mentioned child only.

The leading reason why children did not wear a helmet was not owning one (30%). The second most cited reason (18%) was that the children only rode in safe areas, followed by helmets being uncomfortable (15%).

Because only the first-mentioned reason for non-use was recorded, the percentage of children who did not wear helmets because of the cost may be underestimated. Parents in the lowest income households were far more likely than those in the highest income households to report that their children did not wear a helmet because they did not own one (Chart 2). Since these parents were also less likely to perceive injuries as the leading cause of death among children, they may have been less likely to consider a bicycle helmet a necessary purchase.

Table 2
Bicycle use and helmet use, population aged 12 and older, by sex and age group, Canada, 1994/95

	Population	Bicycle users†	Bicycle use rate	Helmet users‡	Helmet use rate
	'000	'000	% of population	'000	% of bicycle users
Both sexes	23,949	6,856	29	1,304	19
12-14	1,312	820	62	133	16
15-19	2,088	1,029	49	85	8
20-44	11,331	3,651	32	874	24
45 and over	9,217	1,357	15	212	16
Males	11,780	3,938	33	764	19
12-14	686	508	74	105	21
15-19	1,082	637	59	42	7
20-44	5,644	1,967	35	467	24
45 and over	4,368	826	19	150	18
Females	12,168	2,919	24	539	18
12-14	626	312	50	28	9
15-19	1,006	391	39	43	11
25-44	5,687	1,684	30	407	24
45 and over	4,849	531	11	62	12

Data source: National Population Health Survey, 1994/95

Note: Because of rounding, detail may not sum to totals.

† Based on respondents who cycled in past three months

‡ Bicycle users who always wear a helmet

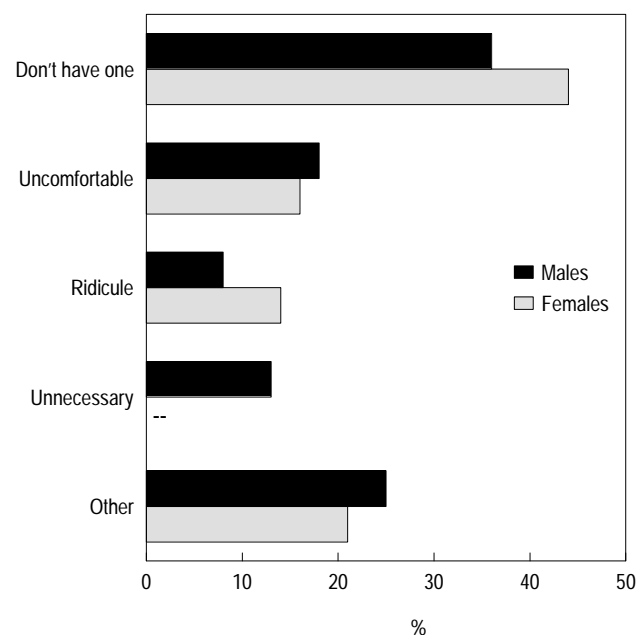
Teenagers shun helmets

In 1994/95, 1.85 million teenagers (aged 12-19) were bicycle riders (Table 2). Cycling declined from 62% at ages 12-14 to 49% at ages 15-19, perhaps reflecting the transition from two wheels to four. Teenage boys were more likely than girls to be cyclists.

Rates of helmet use among teenagers were much lower than among children, and fell sharply among older teenagers. At ages 12-14, 16% of cyclists always wore a helmet, but by ages 15-19, the percentage was just 8%. Overall, the rate of helmet use by teenage boys was somewhat higher than that for girls.

Teenagers' reasons for not wearing helmets also differed by sex (Chart 3). The leading reason was lack of a helmet, but this was more common among girls than boys (44% versus 36%) and increased with age (Table 3). Discomfort ranked next for both sexes. Girls were more likely than boys to cite fear

Chart 3
Percentage distribution of teenage cyclists[†] main reason[‡] for not wearing helmet, by sex, Canada, 1994/95



Data source: National Population Health Survey, 1994/95

[†] Aged 12-19 who cycled in past three months

[‡] Interviewers recorded only one reason.

-- Amount too small to be expressed

of ridicule. Significantly, the fear of ridicule was a more important deterrent for 12-14-year-olds than for any other age group.

Adult cycling

Bicycle use was less common at older ages than among children and teenagers. Just 32% of 20-44-year-olds were bicycle riders; at age 45 and over, the rate was 15%. Men in both age groups had higher rates of bicycle use than did women.

Cyclists aged 20-44 were somewhat more likely than teenagers to wear helmets: 24% always wore one. By age 45 and older, helmet use declined, particularly among women.

Similar to younger age groups, adults' chief reason for not wearing a helmet was not owning one (Table 3).

Table 3
Percentage distribution of main reason for not wearing helmet, cyclists aged 12 and older,[†] by age and sex, Canada, 1994/95

Main reason [‡]	Age group				Total
	12-14	15-19	20-44	45+	
Both sexes ('000)	682	944	2,774	1,140	5,540
			%		
Don't have one	32	44	52	48	47
Uncomfortable	22	14	14	10	14
Unnecessary	--	12	8	10	9
Ridicule	14	8	2	--	4
Other	24	23	24	30	25
Males ('000)	398	596	1,497	672	3,162
			%		
Don't have one	32	38	47	48	44
Uncomfortable	--	15	16	--	15
Unnecessary	--	16	9	10	11
Ridicule	--	--	--	--	4
Other	26	23	25	30	26
Females ('000)	284	348	1,278	468	2,378
			%		
Don't have one	32	54	58	49	52
Uncomfortable	--	--	12	--	13
Unnecessary	--	--	7	--	7
Ridicule	--	--	--	--	5
Other	--	21	21	29	23

Data source: National Population Health Survey, 1994/95

Notes: Because of rounding, column percentages may not sum to 100%. Excludes reason not stated.

[†] Based on respondents who cycled in past three months.

[‡] Interviewers recorded only one reason.

-- Amount too small to be expressed

Regional and socioeconomic variations

Bicycle helmet use by the population aged 12 and older varied across regions. Usage rates were highest in Ontario and British Columbia, again possibly reflecting provincial legislation or impending legislation; the lowest rates were in the Prairies and Quebec (Table 4).

Table 4
Bicycle use and helmet use, population aged 12 and older, by selected characteristics, Canada, 1994/95

	Population	Bicycle users [†]	Bicycle use rate	Helmet users [‡]	Helmet use rate
	'000	'000	% of population	'000	% of bicycle users
Total	23,949	6,856	29	1,304	18
Sex[§]					
Male	11,780	3,938	33	764	18
Female	12,168	2,919	24	539	17
Region[§]					
Atlantic	1,983	383	19	64	17
Quebec	6,030	1,899	32	271	13
Ontario	9,050	2,443	27	538	20
Prairies	3,849	1,168	30	155	12
British Columbia	3,037	964	32	275	27
Rural/Urban[¶]					
Rural	3,058	741	24	78	10
Urban	11,740	3,655	31	685	18
Household income^{**}					
Lowest	1,288	293	24	29	6
Lower-middle	2,768	606	22	94	16
Middle	6,901	1,788	26	239	12
Upper-middle	8,278	2,651	32	531	19
Highest	3,651	1,235	34	378	28
Education^{**}					
Less than high school	7,863	2,315	24	269	9
High school completion	3,570	941	24	117	11
Some postsecondary	5,550	1,532	25	332	18
Certificate/Diploma	3,787	995	26	184	14
University degree	3,145	1,064	37	402	29

Data source: National Population Health Survey, 1994/95

Note: Rates of bicycle use and helmet use are age-adjusted to the 1994/95 population.

[†] Based on respondents who cycled in past three months

[‡] Cyclists who always wear a helmet

[§] Because of rounding, detail may not sum to totals.

[¶] Rural/urban does not sum to total because of a category added to ensure confidentiality.

^{**} Does not sum to total because of not stated category which is not shown.

As is the case for children, adults' bicycle helmet use was lower in rural than in urban areas. While 18% of urban cyclists always wore a helmet, the rate for rural residents was 10%.

And among adults, too, helmet use was associated with high income. The helmet use rate was 28% for cyclists in the highest income households, compared with 6% for those in households with the lowest incomes.

The pattern was similar for education, with helmet use ranging from 29% for cyclists with a university degree to 9% for those who had not graduated from high school.

In provinces that had legislation or pending legislation, the percentage of cyclists who did not always wear a helmet because they did not have one was comparatively low (Table 5). This suggests that legislation may be a factor in the acquisition of helmets.

Implications

Cycling accidents are responsible for a substantial number of injuries, particularly head injuries. A recent study in Kingston, Ontario, using data from the Canadian Hospitals Injury Reporting and Prevention Program, found that about 8% of injuries to those under age 20 were attributable to

Table 5
Percentage distribution of main reason for not wearing helmet, cyclists[†] aged 12 and older, by region, Canada, 1994/95

Main reason [‡]	Region				
	Atlantic	Quebec	Ontario	Prairies	British Columbia
Cyclists who did not wear helmet ('000)	318	1,627	1,897	1,012	686
			%		
Don't have one	55	48	45	51	44
Uncomfortable	9	17	14	11	12
Unnecessary	9	12	8	6	--
Ridicule	6	--	6	3	--
Only ride in safe areas	--	8	6	6	--
Other	18	11	21	22	24

Data source: National Population Health Survey, 1994/95

Notes: Because of rounding, column percentages may not sum to 100%. Excludes reason not stated.

[†] Based on respondents who cycled in past three months.

[‡] Interviewers recorded only one reason.

cycling, and in a retrospective study of 880 children with head injuries, 12% involved bicycles.^{12,13} As well, previous research suggests that almost nine out of ten cyclists fatally injured in bicycle accidents had sustained injuries to the neck and head¹⁴ (see *Cycling deaths*).

The use of helmets has been shown to reduce the risk of serious head injury by up to 85%, and the risk of serious brain injury by nearly 90%.^{4,7} Yet just 4% of persons involved in fatal bicycle-related accidents in Ontario between 1986 and 1991 had been wearing a helmet.¹⁵ Although it has been argued that when a car is involved, bicycle helmets offer less protection, mounting evidence suggests that this protection applies regardless of the involvement of a motor vehicle.^{4,16-20} Time-series analyses of hospital-based surveillance data also support the potential benefit of helmets with, in some cases, a reduction of up to 50% in head injuries.²¹

But despite the known benefits, 1994/95 NPHS data shows that children were the only age group with a majority of regular helmet-users, and 42% of them did not always wear a helmet when they rode bicycles or tricycles. Teenagers were the most resistant to helmet use. Adults' helmet use rates were somewhat higher, but only a minority of cyclists aged 20 and older always wore one.

Even so, although national long-term estimates are not available, bicycle helmet use in some Canadian metropolitan areas has increased substantially within a relatively short time. Between 1988 and 1991, the prevalence of helmet use among youth in Ottawa rose from about 2% to 21%.²² The increase among children in metropolitan Toronto

was from 3% to 12%.²³ In the Montérégie administrative region of Quebec, helmet use by the school population went from just over 1% in 1988 to 33% in 1993.²⁴ In each of these urban areas, a community campaign may have been partly responsible for the changes.

Reasons reported to the NPHS for not wearing bicycle helmets suggest a number of strategies that might be pursued to encourage compliance. Concerns about discomfort and the fear of ridicule suggest that the design of helmets may be a factor in their use. Fear of ridicule was most pronounced at ages 12-14. However, if helmets are perceived as normal, stylish or a status symbol, peer pressure can support use.²⁵ Ideally, programs directed at encouraging helmet use would address issues of style, comfort, and social acceptability.^{26,27}

However, at all ages, the leading reason for not wearing a helmet was not owning one. This indicates that the cost of helmets may be a barrier to use. The substantial share of children in low income households who did not have a helmet (52%) is consistent with earlier research, which showed that persons with lower levels of income were less likely to have protective devices, such as smoke detectors, seat belts, fire extinguishers, and bicycle helmets.^{28,29}

Because a sizeable proportion of cyclists, particularly males aged 15-19, considered helmets to be unnecessary, ongoing public education is an essential component of injury prevention. Educational strategies to increase helmet use may include the involvement of influential groups, such as pediatricians or family physicians, as well as incentives to reduce the cost of helmets. The media have figured in the most successful of these efforts.³⁰⁻³³

However, current research suggests that education alone is not sufficient to reach and maintain high levels of helmet use and that legislation is needed.^{34,35} Moreover, some evidence indicates that legislation may be more cost-effective than community- or school-based intervention programs.³⁶ According to the 1994/95 NPHS, provinces with legislation tend to have higher percentages of both helmet owners and users.

Cycling deaths

Between 1980 and 1994, there were 1,665 bicycle-associated deaths in Canada, 57% of which involved persons younger than 20. Bicycle-associated injuries accounted for 4% of all injury deaths among children younger than 10, 10% among children aged 10-14, and 2% among 15-19-year-olds. Almost two-thirds of the bicycle fatalities involved head injuries. Half of the deaths (50%) occurred in the months of June, July, and August. In both the child and adult populations, the largest proportion of bicycle-related fatalities occurred among males (80% and 81%, respectively).

Limitations

High rates of bicycle helmet use among children aged 12 and younger may reflect parents giving socially desirable answers. An alternative interpretation is that parents have more control over young children and are able to ensure that helmets are worn. Nonetheless, parents are reporting their perceptions, and once children are out of the range of direct parental supervision, helmet use may decline. A recent report suggests that adults tend to over-report children's helmet use relative to what is observed in the community and the schools.³⁷

The data collected on child and adult cyclists were not the same. For instance, the sex of children aged 12 and younger is not available.

Unlike some other studies,³⁸ this analysis cannot report usage rates among helmet owners. The survey did not ask a direct question about helmet ownership. People who cycled and did not always wear a helmet were asked why, but interviewers noted only their first response. In some cases, non-users said that they did not own a helmet, but in others, they mentioned reasons such as comfort and concerns about appearance. Therefore, it was not possible to determine what percentage of cyclists actually owned a helmet and what percentage of them did not wear it.

The use of bicycles by the population aged 12 and older may be somewhat underestimated. The NPHS asked about bicycle use "in the past three months." If the interview occurred in the winter or early spring, some respondents who rode bicycles when road conditions were more favourable would not have been recorded as cyclists.

The introduction of such legislation has had a demonstrable effect on bicycle-related injuries in other countries. Generally, after these laws were enacted, helmet use increased substantially and injury rates decreased correspondingly. Although one study suggests that this is partly attributable to a reduced number of riders, the net effect remains clearly beneficial. For example, in Victoria, Australia, after legislation made bicycle helmets mandatory,³⁹ there was a marked increase in rates of use to between 70% and 90% within a year and a substantial decline in head injuries and mortality.^{40,41}

Some bicycle helmet laws affect only children; others are more comprehensive. Targeting children may be based on the assumption that adults would be more likely to challenge regulations and that children are most at risk.⁴² However, making laws applicable to the entire population would reinforce their importance, and peer disapproval might be reduced.⁴³ More important, from a public health

perspective, although young people may be targeted because of their greater use of bicycles, bicycle-associated injuries create a health burden regardless of age.

References

- 1 Stephens T, Craig CL. *The Well-Being of Canadians. Highlights of the 1988 Campbell's Survey*. Ottawa: Canadian Fitness and Lifestyle Research Institute, 1990.
- 2 Transport Canada. *Traffic Collision Statistics in Canada, 1993* (TP 11743E) Ottawa: Transport Canada, 1996.
- 3 Jaffe KM, Massagli TL, Martin KM, et al. Pediatric traumatic brain injury: Acute and rehabilitative costs. *Archives of Physical Medical Rehabilitation* 1993; 74(7): 681-6.
- 4 Thompson RS, Rivara FP, Thompson DC. A case control study of the effectiveness of bicycle safety helmets. *New England Journal of Medicine* 1989; 320(21): 1361-7.
- 5 McDermott FT, Lane JC, Brazenor GA, et al. The effectiveness of bicyclist helmets: A study of 1,710 casualties. *Journal of Trauma* 1993; 34(6): 834-44.
- 6 Thomas S, Acton C, Nixon J. Effectiveness of bicycle helmets in preventing head injury in children: Case control study. *British Medical Journal* 1994; 308(6922): 173-6.
- 7 Maimaris C, Summers CL, Browning C, et al. Injury patterns in cyclists attending an accident and emergency department: A comparison of helmet wearers and non-wearers. *British Medical Journal* 1994; 308(6943): 1537-40.
- 8 Catlin G, Will P. The National Population Health Survey: Highlights of initial developments. *Health Reports* (Statistics Canada, Catalogue 82-003) 1992; 4(3): 313-9.
- 9 Tambay J-L, Catlin G. Sample design of the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(1): 29-38.
- 10 Ni H, Sacks JJ, Curtis L, et al. Evaluation of a statewide bicycle helmet law via multiple measures of helmet use. *Archives of Pediatric and Adolescent Medicine* 1997; 151(1): 59-65.
- 11 World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries, and Causes of Death*. Based on the Recommendations of the Ninth Revision Conference, 1975. Geneva: World Health Organization, 1977.
- 12 Bienefeld M, Pickett W, Carr PA. A descriptive study of childhood injuries in Kingston, Ontario, using data from a computerized injury surveillance system. *Chronic Diseases in Canada* 1996; 17(1): 21-7.
- 13 Ivan LP, Choo SH, Ventureyra ECG. Head injuries in childhood: A 2-year survey. *Canadian Medical Association Journal* 1983; 128(3): 281-4.
- 14 Fife D, Davis J, Tate L, Wells JK, et al. Fatal injuries to bicyclists: The experience of Dade County, Florida. *Journal of Trauma* 1983; 23(8): 745-55.
- 15 Rowe BH, Rowe AM, Bota GW. Bicyclist and environmental factors associated with fatal bicycle-related trauma in Ontario. *Canadian Medical Association Journal* 1995; 152(1): 45-53.

- 16 Wasserman RC, Waller JA, Monty MJ, et al. Bicyclists, helmets and head injuries: A rider-based study of helmet use and effectiveness. *American Journal of Public Health* 1988; 78(9): 1220-1.
- 17 Dorsch M, Woodward A, Somers RL. Do bicycle safety helmets reduce severity of head injury in real crashes? *Accident Analysis and Prevention* 1987; 19(3): 183-90.
- 18 Bishop P, Briard B. Impact performance of bicycle helmets. *Canadian Journal of Applied Sports Science* 1984; 9(2): 94-101.
- 19 Thompson DC, Thompson RS, Rivara FP, et al. A case-control study of the effectiveness of bicycle safety helmets in preventing facial injury. *American Journal of Public Health* 1990; 80(12): 1471-4.
- 20 Thompson DC, Rivara FP, Thompson RS. Effectiveness of bicycle safety helmets in preventing head injuries. A case-control study. *Journal of the American Medical Association* 1996; 276(24): 1968-73.
- 21 Pitt WR, Thomas S, Battistutta D, et al. Trends in head injuries among child bicyclists. *British Medical Journal* 1994; 308(6922): 177.
- 22 Cushman R, Pless R, Hope D, et al. Trends in bicycle helmet use in Ottawa from 1988 to 1991. *Canadian Medical Association Journal* 1992; 146(9): 1581-5.
- 23 Hu X, Wesson DE, Parkin PC, et al. Current bicycle helmet ownership, use and related factors among children in metropolitan Toronto. *Canadian Journal of Public Health* 1994; 85(2): 121-4.
- 24 Farley C, Haddad S, Brown B. The effects of a 4-year program promoting bicycle helmet use among children in Quebec. *American Journal of Public Health* 1996; 86(1): 46-51.
- 25 Otis J, Lesage D, Godin G, et al. Predicting and reinforcing children's intentions to wear protective helmets while bicycling. *Public Health Reports* 1992; 107(3): 283-9.
- 26 MacKenzie EJ, Shapiro S, Siegel JH. The economic impact of traumatic injuries: One year treatment-related expenditures. *Journal of the American Medical Association* 1988; 260(22): 3290-6.
- 27 Dewar RE. Bicycle riding practices: Implications for safety campaigns. *Journal of Safety Research* 1978; 10: 35-42.
- 28 Parkin P, Spence L, Hu X, et al. Bicycle helmet promotion programs—Canada, Australia, and the United States. *Morbidity and Mortality Weekly Report* 1993; 42(11): 203-10.
- 29 DiGiuseppi CG, Rivara FP, Koepsell TD. Attitudes toward bicycle helmet ownership and use among school-age children. *American Journal of Diseases in Childhood* 1990; 144(1): 83-6.
- 30 Ruch-Ross HS, O'Connor KG. Bicycle helmet counseling by pediatricians: A random national survey. *American Journal of Public Health* 1993; 83(5): 728-30.
- 31 Dannenberg AL, Vernick JS. A proposal for the mandatory inclusion of helmets with new children's bicycles. *American Journal of Public Health* 1993; 83(5): 644-6.
- 32 Dannenberg AL, Gielen AC, Beilenson PL, et al. Bicycle helmet laws and educational campaigns: An evaluation of strategies to increase children's helmet use. *American Journal of Public Health* 1993; 83(5): 667-74.
- 33 Schwartz HI, Brison RJ. Bicycle-related injuries in children: A study in two Ontario emergency departments, 1994. *Chronic Diseases in Canada* 1996; 17(2): 56-62.
- 34 Dowswell T, Towner EML, Simpson G, et al. Preventing childhood unintentional injuries: What works? A literature review. *Injury Prevention* 1996; 1: 140-9.
- 35 Henderson M. *The effectiveness of bicycle helmets: A review*. New South Wales, Australia: Motor Vehicle Accidents Authority of New South Wales, 1995.
- 36 Hatziafreu EJ, Sacks JJ, Brown R, et al. The cost effectiveness of 3 programs to increase use of bicycle helmets among children. *Public Health Reports* 1995; 110(3): 251-9.
- 37 Sacks JJ, Kresnow MJ, Houston B, et al. Bicycle helmet use among American children, 1994. *Injury Prevention* 1996; 2: 258-62.
- 38 Rodgers GB. Bicycle helmet use patterns in the United States. A description and analysis of national survey data. *Accident Analysis and Prevention* 1995; 27(1): 43-56.
- 39 McDermott FT. Helmets for bicyclists: Another first for Victoria. *Medical Journal of Australia* 1991; 154(3): 156-7.
- 40 Wood T, Milne P. Head injuries to pedal cyclists and the promotion of helmet use in Victoria, Australia. *Accident Analysis and Prevention* 1988; 20(3): 177-85.
- 41 Vulcan AP, Cameron MH, Watson WL. Mandatory bicycle helmet use: Experience in Victoria, Australia. *World Journal of Surgery* 1992; 16(3): 389-97.
- 42 Runyan CW, Runyan DK. How can physicians get kids to wear bicycle helmets? A prototypic challenge in injury prevention. *American Journal of Public Health* 1991; 81(8): 972-3.
- 43 Dannenberg AL, Coté TR, Kresnow MJ, et al. Bicycle helmet use by adults: The impact of companionship. *Public Health Reports* 1993; 108(2): 212-7.

The risks of childbearing at older ages

Ying C. MacNab, Julie Macdonald and Terry A. Tuk

Abstract

Objectives

This article investigates whether, compared with younger women, those aged 30-34 and 35 and older experienced a higher risk of adverse pregnancy outcomes and maternal complications, and whether their infants faced an increased risk of perinatal complications and congenital anomalies.

Data source

The analysis is based on data from the British Columbia birth registry for all 342,219 liveborn and stillborn births to women aged 20 and older between 1987 and 1994.

Analytical techniques

Crude odds ratios comparing mothers' age groups were calculated for selected maternal and infant complications and congenital anomalies, by parity. Multiple logistic regression was used to obtain odds ratios for pregnancy outcomes.

Main results

For both parity groups, the odds of having a cesarean delivery increased with maternal age. An elevated risk of having a low birth weight infant or preterm birth was also found for older primiparous women. There was a higher risk of chromosomal anomalies for infants of older mothers. The risk of some maternal complications increased with age, yet for most perinatal complications there was no clear age effect.

Key words

cesarean section, low birth weight, preterm birth, stillbirth, maternal complications, perinatal complications, congenital anomalies

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During the last 20 years, there has been a growing tendency for mothers to have their first child later in life. As a result, the proportion of Canadian women giving birth for the first time at age 35 or older has risen, a pattern that has also occurred in other industrialized nations.¹⁻⁵

Pregnancy at older ages has been associated with an increased risk of various maternal complications, cesarean section, preterm birth, and low birth weight.^{2,3,6} Other studies, however, have not found significant associations.^{7,8}

Using data from the British Columbia birth registry for 1987 to 1994, this article investigates whether, compared with younger pregnant women, those aged 30-34 and 35 and older experienced a higher risk of adverse pregnancy outcomes and maternal complications, and whether their infants faced an increased risk of perinatal complications and of congenital anomalies.

More births to older mothers

In 1994, the majority (51%) of live births in British Columbia were to mothers in their twenties. Nonetheless, 13% of all live births that year were to mothers aged 35 and older, up from 9% in 1987 (Chart 1). And of the 6,289 infants born to older mothers in 1994, 1,774 were first births, more than double the number in 1987 (Table 1).

In part, the number of infants born to women aged 35 and older rose because the number of women in this age group increased. However, when expressed as a rate, the trend toward later maternal age persists. Between 1987 and 1994, the live birth

rate rose from 4.9 to 6.7 per 1,000 British Columbian women aged 35 and older.

Adverse pregnancy outcomes

To calculate the risk of an adverse pregnancy outcome, odds ratios comparing age groups were calculated separately by parity, that is, by whether the mother had given birth before (see *Methods*). Parity distinguishes primiparous women (first-time mothers) from multiparous women (mothers of second or subsequent infants).

With the exception of stillbirth, the risk of an adverse pregnancy outcome increased with age for

Methods

Data source

This analysis uses birth data from 1987 to 1994 obtained from the British Columbia Birth Registry at the British Columbia Vital Statistics Agency, Ministry of Health and Ministry Responsible for Seniors. The primary source of these data—the Physician's Notice of Birth—is submitted to the Agency within 48 hours after a live birth or stillbirth. A total of 342,219 live births and stillbirths were considered: 140,824 to primiparous women and 201,395 to multiparous women.

Analytical techniques

Rates and crude odds ratios together with 95% Cornfield confidence intervals⁹ were calculated to compare maternal age groups for categories of maternal and infant complications and congenital anomalies by maternal age and parity (Appendix, Tables A to D). The maternal and infant complications were selected on the basis of their potential impact on the health of mothers and/or their infants.

The impact of age on adverse pregnancy outcomes was assessed using multiple logistic regression. The fitted model for each adverse pregnancy outcome included as predictor variables categories of maternal and infant complications and congenital anomalies. Residual diagnostic plots and goodness-of-fit tests showed no evidence of problems with fit.

Throughout this article, women aged 20-29 form the reference group; that is, odds were calculated for primiparous women and multiparous women aged 30-34 and 35 and older relative to women of the same parity aged 20-29.

Limitations

The findings were derived from counts of liveborn or stillborn infants, where each infant was classified as one birth. Because counts of infants and not mothers were used, a woman was counted more than once if she had a multiple birth. For example, in counting cesarean sections, a mother who had twins was counted twice. The numbers of women with low birth weight, preterm or stillborn babies were similarly overestimated. Odds ratios and confidence intervals were affected by this multiple counting as well as by the lack of independence of the results for multiple infants of one mother. Since multiple births tend to occur more often as maternal age increases,¹⁰ the negative implications of advanced maternal age may be somewhat overstated.

To investigate whether any overestimates were significant enough to affect the conclusions, the data were disaggregated into multiple and single births. From 1987 to 1994 there were 7,370 multiple births: 2,936 to primiparous women and 4,434 to multiparous women. Counts, crude odds ratios and their confidence intervals were recalculated using estimated counts of mothers. The results showed only small differences that did not affect the conclusions. Crude odds ratios and odds ratios from multiple regression were also recalculated using single births only. (For single births, counting babies is equivalent to counting mothers.) Again, this yielded only small differences that did not affect the conclusions presented here.

Pregnancy and birth are influenced by social and economic factors, maternal health and lifestyle, as well as by biological factors. However, this study does not adjust for factors such as the effects of smoking, maternal nutrition, maternal body mass, gestational weight gain during pregnancy or socioeconomic status.

Table 1
Live births to women aged 35 and older, British Columbia, 1987 to 1994

	Total live births to women aged 35+			First live births to women aged 35+			Female population in B.C. aged 35+
		%†	Annual rate‡		%§	Annual rate‡	
1987 - 1994	39,396	11.0	5.9	10,227	2.9	1.5	6,672,684
1987	3,638	8.7	4.9	883	2.1	1.2	735,751
1988	4,119	9.6	5.4	989	2.3	1.3	760,103
1989	4,309	9.9	5.5	1,087	2.5	1.4	787,553
1990	4,832	10.7	5.9	1,213	2.7	1.5	817,000
1991	4,983	11.0	5.9	1,279	2.8	1.5	845,255
1992	5,347	11.7	6.1	1,381	3.0	1.6	875,639
1993	5,879	12.8	6.5	1,621	3.5	1.8	908,343
1994	6,289	13.4	6.7	1,774	3.8	1.9	943,040

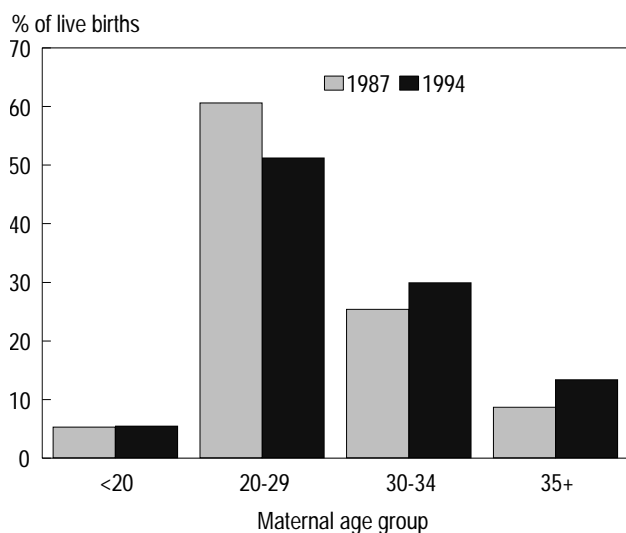
Source: MacNab YC (reference 11)

† Live births to women aged 35 and older as a percentage of live births to women of all ages

‡ Births per 1,000 women aged 35 and older in British Columbia

§ First live births to women aged 35 and older as a percentage of first live births to women of all ages

Chart 1
Percentage distribution of maternal age groups for live births, British Columbia, 1987 and 1994



Source: MacNab YC (reference 11)

Note: Derived from counts of liveborn infants.

Table 2
Odds ratios for adverse pregnancy outcomes, by parity and maternal age, British Columbia, 1987 to 1994

Pregnancy outcomes	Maternal age			
	30 - 34		35 and older	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Cesarean section				
Primiparous	1.32*	1.27, 1.36	1.83*	1.74, 1.93
Multiparous	1.17*	1.13, 1.20	1.39*	1.34, 1.44
Low birth weight†				
Primiparous	1.08*	1.02, 1.14	1.29*	1.19, 1.40
Multiparous	.93*	.89, .98	1.06	.99, 1.13
Preterm‡				
Primiparous	1.16*	1.11, 1.22	1.35*	1.26, 1.46
Multiparous	.89*	.85, .93	1.11*	1.05, 1.18
Stillbirth				
Primiparous	.96	.83, 1.12	1.03	.84, 1.27
Multiparous	.93	.81, 1.07	1.19*	1.01, 1.40

Data source: British Columbia Birth Registry, B.C. Vital Statistics Agency

Note: The odds ratios were derived from counts of live born or stillborn infants. Separate multiple logistic regressions for each parity group and each pregnancy outcome were computed. Other independent variables in the regression, not shown in the table, include selected maternal and perinatal complications and congenital anomalies. Maternal age group 20-29 was used as the reference group.

† Less than 2,500 g

‡ Gestation less than 37 weeks

* p ≤ 0.05

first-time mothers (Table 2). For example, primiparous women aged 30-34 faced significantly higher odds of cesarean section (odds ratio 1.32) and of preterm birth (odds ratio 1.16) than primiparous women aged 20-29. They also had a slightly elevated risk of delivering a low birth weight infant (odds ratio 1.08). Their counterparts aged 35 and older had even higher risks of cesarean delivery (odds ratio 1.83), preterm birth (odds ratio 1.35), and low birth weight infant (odds ratio 1.29).

For women who had given birth before, only the risk of cesarean section clearly rose with age. Multiparous women aged 30-34 had significantly higher odds of cesarean section (odds ratio 1.17) than did those aged 20-29. Multiparous women aged 35 and older faced an even higher risk (odds ratio 1.39).

For stillbirth, the pattern was not as evident. The odds of stillbirth among multiparous women aged 30-34 were not significantly different from those for their counterparts aged 20-29. But the odds were slightly elevated for multiparous women aged 35 and older (odds ratio 1.19). Another study based on neonatal data aggregated from 1961 to 1993 noted a relationship between advanced maternal age and fetal death.¹² For low birth weight and preterm birth, an age effect was not found among multiparous women.

Maternal complications

Overall, delayed childbearing entailed a heightened risk of maternal complications (Table 3). First-time mothers aged 30-34 faced increased odds for eight maternal complications compared with those aged 20-29: antepartum hemorrhage; diabetes mellitus and gestational diabetes; multiple gestation; malposition and malpresentation of fetus, disproportion and obstructed labour; abnormality of reproductive organs; fetal abnormality affecting mother; abnormality of forces of labour and prolonged labour; and obstetrical trauma (see *Definitions*). Among those aged 35 and older, the odds for seven of these eight complications were higher still, with the exception of obstetrical trauma. In addition, their odds of hypertension/eclampsia were also significantly high.

A similar age effect was evident for women who had given birth before, though their odds were for the most part relatively lower. Multiparous women aged 30-34 faced an increased risk for six of the eleven selected maternal complications: antepartum hemorrhage; hypertension/eclampsia; diabetes mellitus and gestational diabetes; malposition and malpresentation of the fetus, disproportion and obstructed labour; abnormality of the reproductive organs; and abnormality of forces of labour and prolonged labour. For these six complications, the odds were higher for multiparous women aged 35 and older. Elevated odds for a seventh maternal complication (fetal abnormality affecting mother) were also found in the older age group.

Conversely, the odds for postpartum hemorrhage were lower among older mothers. For multiparous

Definitions

Abnormality of the reproductive organs (654.0-654.9): The most common condition in this category is uterine scar, resulting from a previous cesarean section. Also included are maternal congenital abnormalities, such as bicornis uterus and functional abnormalities, such as incompetent cervix.

Fetal abnormality affecting mother (655.0-656.9): These conditions describe circumstances where there is a prenatally known or suspected fetal malformation, disease, damage or other problem that affects the maternal management of the pregnancy. The most frequent condition noted in this group is monitored fetal distress (656.3). Also included are blood group abnormalities leading to antibody problems and fetal hydrocephalus. These conditions are generally identified and coded as prenatal conditions. Maternal codes are applied only if the physician has indicated that pre-knowledge exists and has affected the management of the mother. For example, not every case involving fetal distress is included in this category.

Abnormality of forces of labour and prolonged labour (661.0-662.3): This category refers to prolonged or precipitate labour that is not otherwise qualified or is noted as due to specific abnormal uterine activity such as inertia or hypertonia. The most frequent conditions in this group describe prolonged labour (usually second stage) and secondary uterine inertia (usually described as failure to progress not resulting in cesarean section).

women, the odds of this complication decreased with age.

The higher odds for maternal complications, particularly gestational diabetes, eclampsia and abnormal forces of labour, may reflect functional metabolic, endocrine and hormonal (especially ovarian) changes in older women.

In addition to an age effect, the higher crude odds ratios among older mothers reflect interrelationships among maternal complications. For example, mothers with diabetes tend to have heavier infants. This may contribute to fetopelvic disproportion and lead to obstructed or prolonged labour.

An age effect was not observed for every maternal complication considered. For example,

Table 3
Crude odds ratios for births with maternal complications, by parity and maternal age, British Columbia, 1987 to 1994

Maternal complication (ICD-9 codes)	Maternal age			
	30 - 34		35 and older	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Antepartum hemorrhage (640.0- 641.9)				
Primiparous	1.38*	1.23, 1.54	2.16*	1.86, 2.51
Multiparous	1.12*	1.02, 1.22	1.39*	1.24, 1.54
Hypertension/eclampsia (642.0 - 642.9)				
Primiparous	1.07	1.00, 1.15	1.39*	1.25, 1.53
Multiparous	1.24*	1.13, 1.36	1.87*	1.69, 2.08
Diabetes mellitus and gestational diabetes (648.0, 648.8)				
Primiparous	1.80*	1.65, 1.95	2.66*	2.39, 2.97
Multiparous	1.80*	1.67, 1.94	2.89*	2.66, 3.13
Multiple gestation (651.0 - 651.9)				
Primiparous	1.46*	1.34, 1.58	1.73*	1.53, 1.95
Multiparous	1.03	.96, 1.10	.91	.83, 1.00
Malposition and malpresentation of fetus, disproportion and obstructed labour (652.0 - 653.9, 660.0 - 660.9)				
Primiparous	1.32*	1.27, 1.37	1.46*	1.39, 1.54
Multiparous	1.18*	1.13, 1.23	1.32*	1.25, 1.40
Abnormality of reproductive organs (654.0 - 654.9)				
Primiparous	2.38*	2.07, 2.74	4.12*	3.48, 4.88
Multiparous	1.14*	1.09, 1.18	1.26*	1.20, 1.32
Fetal abnormality affecting mother (655.0 - 656.9)				
Primiparous	1.24*	1.18, 1.30	1.54*	1.43, 1.65
Multiparous	1.05	1.00, 1.11	1.28*	1.20, 1.37
Abnormality of forces of labour and prolonged labour (661.0 - 662.3)				
Primiparous	1.29*	1.22, 1.35	1.44*	1.33, 1.56
Multiparous	1.16*	1.07, 1.26	1.32*	1.20, 1.46
Complications of umbilical cord (663.0 - 663.9)				
Primiparous	.95	.84, 1.07	.94	.77, 1.14
Multiparous	1.04	.95, 1.15	1.10	.97, 1.25
Obstetrical trauma (664.0 - 665.9)				
Primiparous	1.19*	1.03, 1.37	.91	.71, 1.17
Multiparous	1.10	.96, 1.27	1.09	.90, 1.32
Postpartum hemorrhage (666.0 - 666.3)				
Primiparous	.96	.85, 1.09	.87	.70, 1.08
Multiparous	.76*	.68, .84	.67*	.57, .78

Data source: British Columbia Birth Registry, B.C. Statistics Agency

Note: The odds ratios were derived from counts of live born or stillborn infants. Maternal age group 20-29 was used as the reference group.

* $p \leq 0.05$

complications of the umbilical cord showed no significant pattern. And although primiparous women aged 30-34 had slightly higher odds (1.19) of obstetrical trauma than those aged 20-29, there was no age effect overall.

Perinatal complications

Although a clear age effect was not evident for the selected perinatal complications, the odds were elevated in the oldest age group for two of them: fetal growth retardation, small for gestation age

(SGA), fetal malnutrition (primiparous only), and intrauterine hypoxia and birth asphyxia (both parity groups) (Table 4). Like maternal complications, perinatal complications are interrelated. For example, delayed fetal growth is generally due to a process of intrauterine deprivation and is consequently associated with birth asphyxia.

There are two types of fetal growth retardation, both resulting in small organs of subnormal weight. From the data used in this analysis, the type could not be identified. However, Type II SGA infants (who develop from embryonic cells that are normal in number but smaller in size) are identified with maternal preeclampsia (that is, pregnancy-induced hypertension). And pregnant women aged 35 and older have a high risk of preeclampsia, suggesting a preponderance of Type II SGA.

Because preeclampsia is reversible with optimum maternal nutrition,¹⁴ ensuring a good diet among pregnant women, as well as the early detection and control of preeclampsia, could reduce the number of SGA infants. However, any benefits from optimizing nutrition can only be assumed since data on related factors, such as smoking, weight gain during pregnancy or type of fetal growth retardation, were unavailable.

By contrast, the odds of respiratory conditions of fetus and newborn among births to older multiparous women were significantly lower than for births to women aged 20-29.

Congenital anomalies

The risk of chromosomal anomalies—Down syndrome, for the most part—was elevated among older mothers (Table 5). For example, the odds of having an infant with a chromosomal defect for multiparous women aged 35 and older were more than four times those for mothers in the youngest age group. Among first-time mothers aged 35 and older, the odds were also significantly high (odds ratio 3.07).

Despite the elevated risk, the incidence of chromosomal anomalies was very small. For example, among multiparous women, 0.32% of infants born to mothers aged 35 and older had chromosomal anomalies, compared with 0.13% of

Table 4

Crude odds ratios for births with perinatal complications, by parity and maternal age, British Columbia, 1987 to 1994

Perinatal complications (ICD-9 codes)	Maternal age			
	30 - 34		35 and older	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Fetal growth retardation, SGA, fetal malnutrition† (764.0 - 764.9)				
Primiparous	1.04	.95, 1.14	1.36*	1.19, 1.54
Multiparous	.87*	.80, .95	1.00	.90, 1.12
Birth trauma (767.0 - 767.9)				
Primiparous	1.13	.91, 1.41	1.05	.73, 1.51
Multiparous	.84	.66, 1.09	.94	.68, 1.31
Intrauterine hypoxia and birth asphyxia (768.0 - 768.9)				
Primiparous	1.03	.99, 1.06	1.09*	1.04, 1.15
Multiparous	1.02	.99, 1.05	1.08*	1.04, 1.12
Respiratory conditions of fetus and newborn (769, 770.0 - 770.9)				
Primiparous	.85	.71, 1.02	.86	.64, 1.16
Multiparous	.84*	.72, .99	.74*	.58, .94
Isoimmunization disorders and perinatal jaundice (773.0 - 774.7)				
Primiparous	.68	.31, 1.46	1.86	.81, 4.14
Multiparous	.82	.55, 1.20	.88	.52, 1.48

Data source: British Columbia Birth Registry, B.C. Vital Statistics Agency

Note: The odds ratios were derived from counts of live born and stillborn infants. Maternal age group 20-29 was used as the reference group.

† Small for gestational age (SGA) code(s) applied to infants with inappropriate weight for their gestation based on Lubchenko growth chart (reference 13), and/or manifestation of malnutrition.

* $p \leq 0.05$

infants of mothers aged 30-34, and 0.08% of infants of mothers aged 20-29. It has been well documented that the risk of bearing a child with Down syndrome increases with maternal age, although the risk noted elsewhere has been greater than was found here.¹⁵

In addition, the odds of congenital anomalies of the respiratory system among infants born to primiparous women aged 35 and older were significantly high (odds ratio 2.76).

Table 5
Crude odds ratios for births with congenital anomalies, by parity and maternal age, British Columbia, 1987 to 1994

Congenital anomalies (ICD-9 codes)	Maternal age			
	30 - 34		35 and older	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
All anomalies (740.0 - 759.9)				
Primiparous	1.11*	1.08, 1.14	1.23*	1.18, 1.28
Multiparous	1.04*	1.02, 1.06	1.16*	1.13, 1.19
Brain, nervous system and spinal cord (740.0 - 742.9)				
Primiparous	.78	.51, 1.19	.64	.29, 1.36
Multiparous	.90	.66, 1.23	.73	.46, 1.15
Ear, face and neck (744.0 - 744.9)				
Primiparous	.96	.61, 1.51	.66	.26, 1.56
Multiparous	.67*	.46, .97	.76	.46, 1.24
Heart (745.0 - 746.9)				
Primiparous	.91	.59, 1.41	1.46	.81, 2.57
Multiparous	.67*	.46, .97	.92	.58, 1.44
Respiratory system (748.0 - 748.9)				
Primiparous	.34	.08, 1.16	2.76*	1.16, 6.36
Multiparous	.95	.49, 1.80	1.17	.51, 2.59
Musculoskeletal anomalies (754.0 - 756.9)				
Primiparous	1.02	.88, 1.19	.94	.73, 1.22
Multiparous	1.07	.93, 1.23	.97	.80, 1.18
Chromosomal anomalies (758.0 - 758.9)				
Primiparous	1.64*	1.09, 2.48	3.07*	1.86, 5.02
Multiparous	1.62*	1.18, 2.22	4.16*	3.06, 5.66

Data source: British Columbia Birth Registry, B.C. Vital Statistics Agency

Note: The odds ratios were derived from counts of live born and stillborn infants. Maternal age group 20-29 was used as the reference group.

* $p \leq 0.05$

Concluding remarks

For both parity groups, the odds of having a cesarean delivery increased with maternal age. An elevated risk of a low birth weight infant and preterm birth was also found for older primiparous women. For all congenital anomalies combined, there was a slightly higher risk for infants of older mothers, and for chromosomal anomalies in particular, there was a significant difference. The risk of some maternal complications increased with age, yet for most perinatal complications there was no clear age effect.

While childbearing at older ages increases certain negative health impacts to both the mother and her infant, health concerns are not the only factors influencing Canadian women and their partners. Social, economic and personal factors also play a role in family planning. And given the numerous and conflicting forces that affect the timing of childbearing, it is not surprising that these decisions are perhaps more complex for women today than for their mothers.

References

- 1 Ford D, Nault F. Changing fertility patterns, 1974 to 1994. *Health Reports* (Statistics Canada, Catalogue 82-003-XPB) 1996; 8(3): 39-46.
- 2 Cunningham FG, Leveno KJ. Childbearing among older women—The message is cautiously optimistic. *The New England Journal of Medicine* 1995; 333(15): 1002-4.
- 3 Cnattingius S, Forman MR, Berendes HW, et al. Delayed childbearing and risk of adverse perinatal outcome. *Journal of the American Medical Association* 1992; 268(7): 886-90.
- 4 Melchor JC, Rodriguez-Alarcon J, Fernandez-Llebrz L, et al. Delayed childbearing and pregnancy outcome. *Zentralbl Gynakol* 1994; 116: 566-70.
- 5 Mikulandra F, Perisa M, Merlak I, et al. Pregnancy and delivery in women aged 35 years and over. *Zentralblatt für Gynakologie* 1993; 115: 171-6.
- 6 Gordon D, Milbery J, Daling J, et al. Advanced maternal age as a risk factor for caesarean delivery. *Obstetrics and Gynecology* 1991; 77(4): 493-7.
- 7 Barkan SE, Bracken MB. Delayed childbearing: No evidence for increased risk of low birth weight and preterm delivery. *American Journal of Epidemiology* 1987; 125(1): 101-9.

- 8 Kirz DS, Dorchester W, Freeman RK. Advanced maternal age: The mature gravida. *American Journal of Obstetrics and Gynecology* 1984; 152(1): 7-12.
- 9 Breslow NE, Day NE. *Statistical Methods in Cancer Research Volume 1 - The Analysis of Case - Control Studies*. Lyon: IARC Scientific Publications, 1990.
- 10 Millar WJ, Wadhwa S, Nimrod C. Multiple births: Trends and patterns in Canada, 1974-1990. *Health Reports* (Statistics Canada, Catalogue 82-003) 1997; 4(3): 223-50.
- 11 MacNab YC. A review of delivery mode in British Columbia, 1987-1995. *Quarterly Digest* (British Columbia Vital Statistics Agency, Ministry of Health and Ministry Responsible for Seniors) 1997; 6(4): 18-36.
- 12 Frette RC, Schmittiel J, McLean FH, et al. Increased maternal age and the risk of fetal death. *New England Journal of Medicine* 1995; 333(15): 953-7.
- 13 Lubchenko LO, Hansman C, Dressler M, et al. Intrauterine growth as estimated from liveborn birth-weight data at 24 to 42 weeks of gestation. *Pediatrics* 1963; 32: 793-800.
- 14 Reeder SJ, Martin LL, Koniak, D (editors). *Maternity Nursing, Family, Newborn, and Women's Health Care*. 7th ed. Philadelphia: J.B. Lippincott Company, 1992.
- 15 Magalini S, Scarscia E. *Medical Syndromes*. 2nd ed. Philadelphia: J.B. Lippincott Company, 1981.

Appendix

Table A
Births by adverse pregnancy outcomes, parity, and maternal age, British Columbia, 1987 to 1994

Pregnancy outcomes	Maternal age					
	20 - 29		30 - 34		35 and older	
	Number	%	Number	%	Number	%
All births						
Primiparous	97,944	100.0	32,371	100.0	10,509	100.0
Multiparous	103,199	100.0	68,676	100.0	29,520	100.0
Cesarean section						
Primiparous	21,055	21.5	8,895	27.5	3,647	34.7
Multiparous	18,598	18.0	14,197	20.7	7,056	23.9
First cesarean	4,933	4.8	3,638	5.3	1,997	6.8
Repeat cesarean	13,665	13.2	10,559	15.4	5,059	17.1
Low birth weight†						
Primiparous	6,031	6.2	2,314	7.2	958	9.1
Multiparous	5,342	5.2	3,349	4.9	1,592	5.4
Preterm‡						
Primiparous	6,679	6.8	2,772	8.6	1,105	10.5
Multiparous	6,397	6.2	4,075	5.9	2,114	7.2
Stillbirth						
Primiparous	655	0.7	235	0.7	105	1.0
Multiparous	603	0.6	392	0.6	235	0.8

Data source: British Columbia Birth Registry, B.C. Vital Statistics Agency
Note: Derived from counts of live born and stillborn infants. Individuals with more than one condition within a category were counted only once in that category. However, an individual with conditions in more than one category was counted in each one.

† Less than 2,500 g

‡ Gestation less than 37 weeks

Table B
Births with maternal complications, by parity and maternal age, British Columbia, 1987 to 1994

Maternal complications (ICD-9 codes)	Maternal age					
	20 - 29		30 - 34		35 and older	
	Number	%	Number	%	Number	%
All births						
Primiparous	97,944	100.0	32,371	100.0	10,509	100.0
Multiparous	103,199	100.0	68,676	100.0	29,520	100.0
Antepartum hemorrhage (640.0- 641.9)						
Primiparous	967	1.0	438	1.4	222	2.1
Multiparous	1,211	1.2	898	1.3	478	1.6
Hypertension/eclampsia (642.0 - 642.9)						
Primiparous	3,183	3.3	1,123	3.5	468	4.5
Multiparous	1,077	1.0	888	1.3	572	1.9
Diabetes mellitus and gestational diabetes (648.0, 648.8)						
Primiparous	1,586	1.6	929	2.9	441	4.2
Multiparous	1,368	1.3	1,623	2.4	1,102	3.7
Multiple gestation (651.0 - 651.9)						
Primiparous	1,768	1.8	844	2.6	324	3.1
Multiparous	2,278	2.2	1,559	2.3	597	2.0
Malposition and malpresentation of fetus, disproportion and obstructed labour (652.0 - 653.9, 660.0 - 660.9)						
Primiparous	13,014	13.3	5,444	16.8	1,923	18.3
Multiparous	5,173	5.0	4,023	5.9	1,926	6.5
Abnormality of reproductive organs (654.0 - 654.9)						
Primiparous	466	0.5	364	1.1	203	1.9
Multiparous	6,611	6.4	4,959	7.2	2,338	7.9
Fetal abnormality affecting mother (655.0 - 656.9)						
Primiparous	6,022	6.2	2,424	7.5	961	9.1
Multiparous	3,249	3.2	2,274	3.3	1,180	4.0
Abnormality of forces of labour and prolonged labour (661.0 - 662.3)						
Primiparous	5,108	5.2	2,138	6.6	771	7.3
Multiparous	1,483	1.4	1,144	1.7	559	1.9
Complications of umbilical cord (663.0 - 663.9)						
Primiparous	1,122	1.2	352	1.1	113	1.1
Multiparous	1,050	1.0	727	1.1	331	1.1
Obstetrical trauma (664.0 - 665.9)						
Primiparous	725	0.7	284	0.9	71	0.7
Multiparous	468	0.5	343	0.5	146	0.5
Postpartum hemorrhage (666.0 - 666.3)						
Primiparous	1,033	1.1	329	1.0	97	0.9
Multiparous	1,011	1.0	511	0.7	194	0.7

Data Source: British Columbia Birth Registry, B.C. Vital Statistics Agency

Note: Derived from counts of live born and stillborn infants. Individuals with more than one condition within a category were counted only once in that category. However, an individual with conditions in more than one category was counted in each one.

Table C
Births with perinatal complications, by parity and maternal age, British Columbia, 1987 to 1994

Perinatal complications (ICD-9 codes)	Maternal age					
	20 - 29		30 - 34		35 and older	
	No.	%	No.	%	No.	%
All births						
Primiparous	97,944	100.0	32,371	100.0	10,509	100.0
Multiparous	103,199	100.0	68,676	100.0	29,520	100.0
Fetal growth retardation, SGA, fetal malnutrition† (764.0 - 764.9)						
Primiparous	1,964	2.0	676	2.1	284	2.7
Multiparous	1,459	1.4	847	1.2	419	1.4
Birth trauma (767.0 - 767.9)						
Primiparous	310	0.3	116	0.4	35	0.3
Multiparous	178	0.2	100	0.2	48	0.2
Intrauterine hypoxia and birth asphyxia (768.0 - 768.9)						
Primiparous	18,154	18.5	6,132	18.9	2,088	19.9
Multiparous	14,490	14.0	9,792	14.3	4,416	15.0
Respiratory conditions of fetus and newborn (769, 770.0 - 770.9)						
Primiparous	550	0.6	155	0.5	51	0.5
Multiparous	415	0.4	233	0.3	88	0.3
Isoimmunization disorders and perinatal jaundice (773.0 - 774.7)						
Primiparous	40	--	9	--	8	0.1
Multiparous	79	0.1	43	0.1	20	0.1

Data source: British Columbia Birth Registry, B.C. Vital Statistics Agency

Note: Derived from counts of live born and stillborn infants. Individuals with more than one condition within a category were counted only once in that category. However, an individual with conditions in more than one category was counted in each one.

† Small for gestational age (SGA) code(s) applied to infants with inappropriate weight for their gestation based on Lubchenko growth chart (reference 13) and/or manifestation of malnutrition.

-- Amount too small to be expressed

Table D
Births with congenital anomalies, by parity and maternal age, British Columbia, 1987 to 1994

Congenital anomalies (ICD-9 codes)	Maternal age					
	20-29		30 - 34		35 and older	
	No.	%	No.	%	No.	%
All births						
Primiparous	97,944	100.0	32,371	100.0	10,509	100.0
Multiparous	103,199	100.0	68,676	100.0	29,520	100.0
All congenital anomalies (740.0 - 759.9)						
Primiparous	38,431	39.2	13,519	41.8	4,648	44.2
Multiparous	33,987	32.9	23,201	33.8	10,692	36.2
Brain, nervous system and spinal cord (740.0 - 742.9)						
Primiparous	116	0.1	30	0.1	8	0.1
Multiparous	115	0.1	69	0.1	24	0.1
Ear, face and neck (744.0 - 744.9)						
Primiparous	85	0.1	27	0.1	6	0.1
Multiparous	97	0.1	43	0.1	21	0.1
Heart (745.0 - 746.9)						
Primiparous	96	0.1	29	0.1	15	0.1
Multiparous	99	0.1	44	0.1	26	0.1
Respiratory system (748.0 - 748.9)						
Primiparous	27	--	3	--	8	0.1
Multiparous	27	--	17	--	9	--
Musculoskeletal anomalies (754.0 - 756.9)						
Primiparous	672	0.7	227	0.7	68	0.7
Multiparous	486	0.5	345	0.5	135	0.5
Chromosomal anomalies (758.0 - 758.9)						
Primiparous	70	0.1	38	0.1	23	0.2
Multiparous	80	0.1	86	0.1	95	0.3

Data source: British Columbia Birth Registry, B.C. Vital Statistics Agency

Note: Derived from counts of live born and stillborn infants. Individuals with more than one condition within a category were counted only once in that category. However, an individual with conditions in more than one category was counted in each one.

-- Amount too small to be expressed



Reports

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

Divorce in the 1990s

Jane F. Gentleman and Evelyn Park

Abstract

Objectives

This article presents divorce statistics from 1970 through 1995 and focuses on divorce rates in the 1990s.

Data sources

The divorce data are from microdata provided annually to Statistics Canada by the Central Divorce Registry of the Department of Justice Canada. Data from Statistics Canada's 1990 General Social Survey were used to obtain the duration of marriages.

Analytical techniques

The divorce rates presented here are more precise than previously published rates because the denominators of the rates exclude people in common-law unions. Divorce statistics were derived for each sex separately.

Main results

Divorce rates have not changed dramatically in the 1990s and are only slightly higher than in the early 1980s. Divorce rates peak among those who have been married for five years and then decrease as duration of marriage lengthens.

Key words

divorce rates, duration of marriage, common-law

Authors

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As divorce became more commonplace in the 1970s and 1980s, so did the impression that it was not simply increasing, but was soaring upward. A steady rise in the divorce rate during the 1970s was followed by striking fluctuations in the 1980s.

Meanwhile, the number of common-law unions was increasing. Between 1981 and 1995, the number of couples living in common-law arrangements tripled from about 300,000 to over one million. Common-law unions are not legal contracts and are ended without legal proceedings. Consequently, unlike marriages, the dissolution of common-law relationships is not recorded in official registries.

Despite the increase in common-law relationships, married couples are far more numerous. In 1995, there were over 6.3 million married couples in Canada. Thus, divorce data continue to be relevant to the analysis of family dissolution.

This article examines divorce patterns from 1970 to 1995, focusing on the 1990s. It is based on information from the Central Divorce Registry, provided to Statistics Canada by the Department of Justice Canada (see *Methods*). Divorce data indicate that rates have been relatively unchanged in the 1990s and are not very much higher than in the early 1980s.

Divorces peak in 1987

Between 1971 and 1982, the annual number of divorces more than doubled from 29,684 to 70,430 (Table 1). Divorce rates also more than doubled from 135 to 280 per 100,000 population during the same period. From 1982 to 1985, the numbers and rates of divorce declined as some couples postponed divorcing because of anticipated legislation that would liberalize divorce law.

Methods

Data sources

The divorce data in this article are taken from microdata provided annually to Statistics Canada by the Central Divorce Registry of the Department of Justice Canada. The data base includes information specific to each divorcing couple (with 100% coverage), such as dates of birth, marriage, and divorce, marital status immediately before the marriage, etc. These data are maintained and published annually by Statistics Canada.¹⁻³ For additional analyses of national divorce data, see references 4-11.

In recognition of the growing acceptance and prevalence of common-law unions, the 1991 and 1996 Censuses asked two questions to ascertain both the legal marital status and living arrangements of couples. The new questions made it possible to more accurately identify the population at risk of divorce, which comprises only legally married couples. Accordingly, this analysis used population counts of legally married men and women for 1981 through 1995 (based on results from the new questions, intercensal estimates, estimates projected back and estimates based on other census information). As a result, the rates presented here are higher than previously published figures that included individuals in common-law relationships in the denominators. For more information on common-law unions in Canada, see reference 12.

Data from Statistics Canada's 1990 General Social Survey were used to obtain the duration of marriages. That survey had 13,495 respondents aged 15 and older.¹³

Analytical techniques

Divorce statistics were derived for each sex separately to avoid double counting couples who are married but not living together. When the statistics are age-specific, the results for men and women

may differ appreciably because husbands are not generally the same age as their wives. When the statistics are not age-specific, counts of couples should be exactly the same for men and women. However, counts of marriages based on survey data may show small differences between men and women because, for example, some spouses reside outside the country, or because the amount of adjustment for census net undercoverage is different for men and women. Non-age-specific survey results used in this analysis are based on the husband's response.

The analysis also focuses on three 3-year time periods: 1970-72, 1980-82, and 1990-92. Divorce rates for 1980-82 and 1990-92 were calculated using 1981 and 1991 counts, respectively, of the legally married population; divorce rates for 1970-72 used 1971 counts of the legally married and common-law populations combined. Because common-law unions were relatively rare in 1971, it is assumed in this analysis that the 1971 counts are close to counts of the legally married population, and consequently the rates for the three time periods are comparable.

These three periods were chosen for several reasons. Each interval is centred around a census year. Because they exclude the late 1980s when there were notable fluctuations in the divorce rate, they present a clearer view of the overall trend. And using a three-year period reduced the effect of minor fluctuations in the divorce rate from one year to another.

A small number of divorce records indicating that either spouse was older than 87 were omitted from the analysis because the age information was considered to be unreliable. Only for the last few years has Statistics Canada compiled and published annual divorce data for the age group 65 and over; previously, the oldest age group examined was 55 and over.

Under the Divorce Act of 1985, marriage breakdown became the only grounds for divorce, and the evidence required to support this claim was reduced. During the two years after introduction of the Act, numbers and rates of divorces rose dramatically as divorce became easier to obtain and the “backlog” of couples intending to divorce did so under the new law. In the peak year of 1987, 96,200 divorces were granted, a rate of 1,586 divorces per 100,000 legally married couples. Interestingly, from 1986 to 1989, the annual number

of marriages also rose briefly, from 175,518 to 190,640, as divorce freed more people to remarry (Chart 1).

Divorces level off in 1990s

The rise in divorces did not continue. Rates have not changed dramatically in the 1990s, and are only slightly higher than in the early 1980s.

After the spike in 1987, numbers and rates declined through 1991. Between 1991 and 1995, the annual number of divorces levelled off, fluctuating between 77,000 and 79,000. The trend in the divorce rate was similar. At 1,222 divorces per 100,000 legally married couples, the 1995 rate was not much higher than in 1982 (1,215) (Table 1).

Table 1
Divorce rates, Canada, 1971 to 1995

Year	Divorces	Population	Legally married couples†	Divorce rate	
				Per 100,000 population	Per 100,000 legally married couples†
1971	29,684	22,026,421	..	134.8	..
1972	32,389	22,284,545	..	145.3	..
1973	36,703	22,559,471	..	162.7	..
1974	45,016	22,874,718	..	196.8	..
1975	50,608	23,209,191	..	218.1	..
1976	54,202	23,517,495	..	230.5	..
1977	55,365	23,796,383	..	232.7	..
1978	57,154	24,036,347	..	237.8	..
1979	59,470	24,276,926	..	245.0	..
1980	62,017	24,593,341	..	252.2	..
1981	67,671	24,899,999	5,732,702	271.8	1,180.4
1982	70,430	25,201,902	5,798,938	279.5	1,214.5
1983	68,565	25,456,302	5,853,458	269.3	1,171.4
1984	65,170	25,701,754	5,906,643	253.6	1,103.3
1985	61,976	25,941,647	5,958,344	238.9	1,040.2
1986	78,304	26,203,819	6,016,055	298.8	1,301.6
1987	96,200	26,549,745	6,066,426	362.3	1,585.8
1988	83,507	26,894,785	6,111,142	310.5	1,366.5
1989	80,998	27,379,348	6,175,988	295.8	1,311.5
1990	78,463	27,790,593	6,214,499	282.3	1,262.6
1991	77,020	28,120,065	6,238,707	273.9	1,234.6
1992	79,034	28,542,213	6,285,215	276.9	1,257.5
1993	78,226	28,946,987	6,319,319	270.2	1,237.9
1994	78,880	29,251,285	6,328,951	269.7	1,246.3
1995	77,636	29,615,325	6,353,665	262.2	1,221.9

Data source: Health Statistics Division

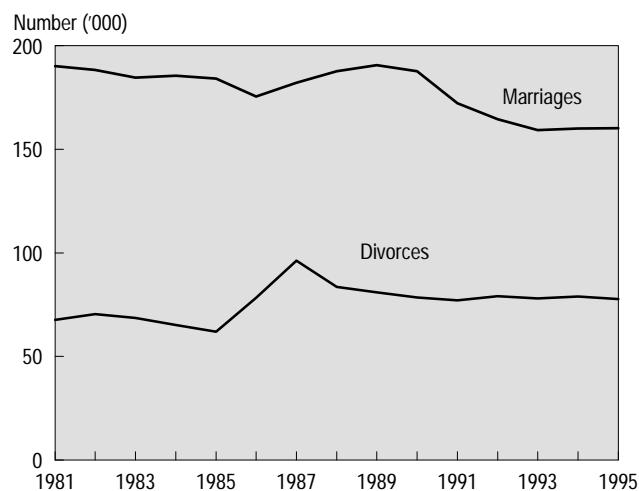
† The number of couples is defined here as the number of men who are legally married.

.. Figures not available

The risk of divorce

About one in one hundred marriages ended in 1995. Thus, for the average couple, the risk of divorcing in a single year is not strikingly high. However, the risk of ever obtaining a divorce is much greater. If 1991 divorce rates prevail, an estimated 31% of couples who married in 1991 will divorce sometime in the future.⁴

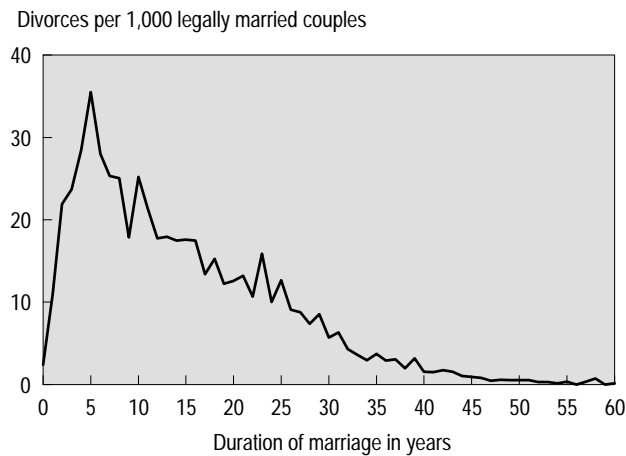
Chart 1
Divorces and marriages, Canada, 1981 to 1995



Data source: Health Statistics Division

In contrast to the annual divorce rate, estimating the chance of a married couple ever divorcing requires complex calculations that take into consideration that a marriage can end other than in divorce, that is, with one spouse dying. Statistics Canada periodically publishes these rates with multi-state marital status life tables derived from marriage, divorce and mortality data.^{4,11}

Chart 2
Divorce rate, by duration of marriage, Canada, 1990



Data sources: Health Statistics Division and 1990 General Social Survey

A five year itch?

Understandably, the risk of divorce is not uniform for all marriages. Duration of the relationship is one of many factors associated with divorce rates. The chance of divorce increases rapidly in the early years of a marriage to peak at five years and then decrease (Chart 2). In 1990, about 4 out of 100 couples who had just had their fifth wedding anniversary obtained a divorce.

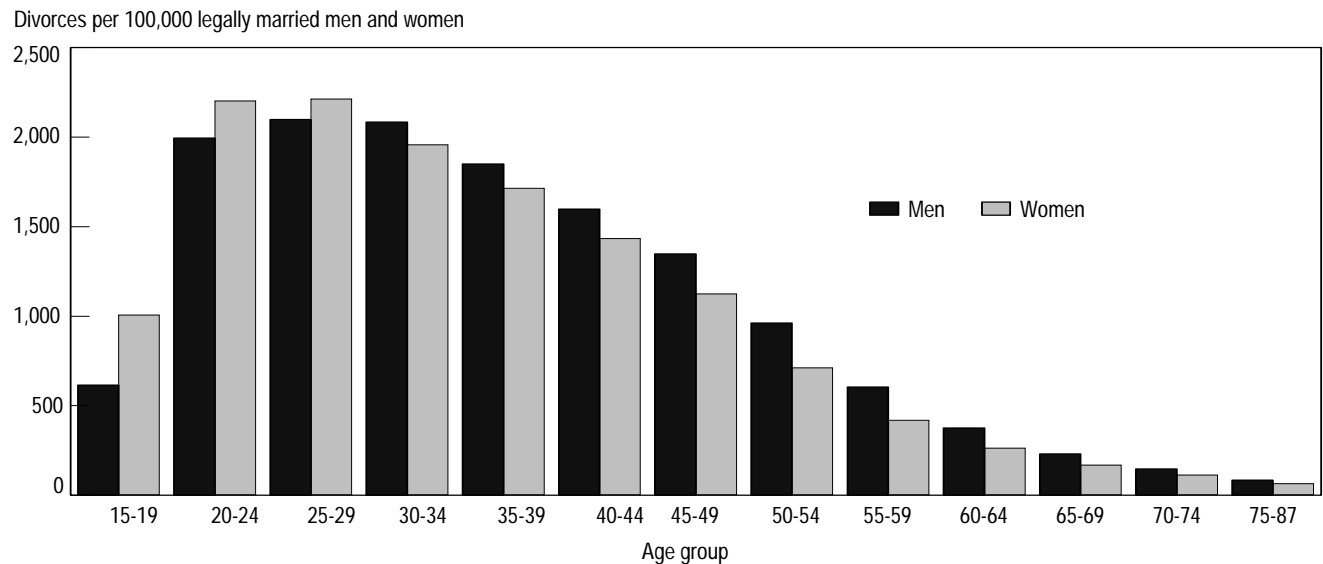
Divorce rates highest among young adults

People in their late twenties are the most susceptible to divorce. In 1990-92, the divorce rate among 25-29-year-old men was 2,099 per 100,000 legally married men. For 25-29-year-old women, the rate was 2,213.

Before age 30, divorce rates are higher for women than for men. At older ages, the situation is reversed (Chart 3). These differences reflect the fact that brides are, on average, younger than grooms.

Though the rates have increased, the overall patterns in divorce rates by age group and sex have prevailed since the early 1970s (Table 2).

Chart 3
Annual divorce rate, by age group, Canada, 1990-92



Data source: Health Statistics Division

Second and subsequent marriages

Not surprisingly, the oldest divorcing men and women have had the longest marriages. For example, for men aged 65-87, the average duration of marriages that ended in divorce in 1990-92 was 26.6 years. But these averages are misleading because the distribution of the length of marriages ending in divorce is bimodal (Chart 4). That is, men

in the oldest age group tend to divorce after having been married for either a short time (2 years), or for a long time (42 years).

When the divorce counts are disaggregated according to whether men aged 65-87 were single or divorced immediately before entering the marriage in consideration that ended in divorce, it is clear that the upper peak in marriage durations corresponds to first marriages that lasted a relatively long time, and the lower peak corresponds to subsequent marriages that lasted a relatively short time. For men aged 65-87, the average duration of first marriages ending in divorce in 1990-92 was 37.8 years, and the peak duration was 42 years. The average duration of their second and subsequent marriages ending in divorce was 14.1 years, with less well-defined peaks at 11 and fewer years.

The pattern was similar for women in the oldest age group. Divorcing women aged 65-87 in 1990-92 had been married an average of 29.1 years, with most of their divorces occurring after either relatively short or relatively long marriages (around 2 and 44 years, respectively).

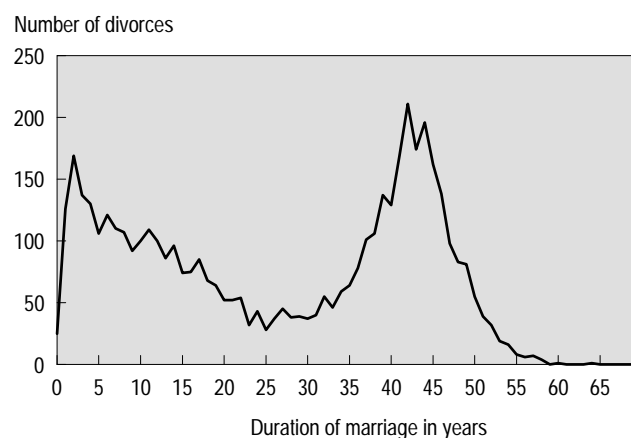
Evidently, the large number of long marriages among the oldest men and women were mostly first marriages, and the large number of short marriages were second or subsequent marriages. This pattern did not hold for younger men or women, who had not lived long enough to have very long marriages.

Table 2
Annual divorce rates, by age group, Canada, three periods

Age group	1970-72		1980-82		1990-92	
	Men	Women	Men	Women	Men	Women
Per 100,000 legally married men or women						
15-19	67.0	215.4	307.8	612.7	614.2	1,006.8
20-24	525.1	708.4	1,260.9	1,606.0	1,995.0	2,201.6
25-29	890.8	961.8	2,022.6	2,124.6	2,099.0	2,212.9
30-34	911.0	854.3	1,977.2	1,761.3	2,083.3	1,957.4
35-39	775.8	717.1	1,639.5	1,455.5	1,849.8	1,713.5
40-44	676.8	630.9	1,298.6	1,123.2	1,597.6	1,434.0
45-49	580.2	515.7	1,002.2	829.5	1,347.7	1,124.4
50-54	490.0	401.3	754.9	561.9	961.4	710.8
55-59	367.8	276.5	483.7	365.6	603.7	417.2
60-64	273.7	174.0	321.3	229.0	374.5	262.6
65-69	187.0	109.4	207.0	159.9	231.3	167.8
70-74	105.9	59.7	135.1	92.9	146.0	112.7
75-87	56.8	33.6	77.1	46.6	84.7	64.5

Data source: Health Statistics Division

Chart 4
Number of divorces, by duration of marriage, men aged 65-87, Canada, 1990-92



Data source: Health Statistics Division

Concluding remarks

Divorce rates have been relatively unchanged in the 1990s, and are not much higher than in the early 1980s. Although the risk of divorce has increased dramatically since 1970, about two out of three marriages will endure until the death of one of the partners.

Acknowledgments

The authors thank François Nault, Margaret Michalowski, and Demography Division at Statistics Canada for providing custom-tabulated counts of legally married persons.

References

- 1 Statistics Canada. *Divorces, 1992 to Divorces, 1995* (Catalogue 84-213-XPB, annual) Ottawa: Minister of Industry, 1995 to 1997.
- 2 Statistics Canada. *Divorces, 1987 - Divorces, 1990. Health Reports* (Catalogue 82-003S17, annual, Suppl. 17) Ottawa: Minister of Industry.
- 3 Statistics Canada. *Marriages and Divorces 1986* (Catalogue 84-205) Ottawa: Minister of Supply and Services Canada, 1986.
- 4 Nault F, Bélanger A. *The Decline in Marriage in Canada, 1981 to 1991* (Statistics Canada, Catalogue 84-536-XPB) Ottawa: Minister of Industry, 1996.
- 5 Gentleman JF, Park E. Age differences of married and divorcing couples. *Health Reports* (Statistics Canada, Catalogue 82-003) 1994; 6(2): 225-40.
- 6 Dumas J. *Marriage and Conjugal Life in Canada* (Statistics Canada, Catalogue 91-534E) Ottawa: Minister of Industry Science and Technology, 1992.
- 7 Lapierre L. Divorces, Canada and the provinces, 1990. *Health Reports* (Statistics Canada, Catalogue 82-003) 1991; 3(4): 380-3.
- 8 Millar W. Divorces, Canada and the provinces, 1989. *Health Reports* (Statistics Canada, Catalogue 82-003) 1991; 3(1): 83-6.
- 9 Adams O. Divorces in Canada, 1988. *Health Reports* (Statistics Canada, Catalogue 82-003) 1990; 2(1): 57-66.
- 10 McKie DC, Prentice B, Reed P. *Divorce: Law and the Family in Canada* (Statistics Canada, Catalogue 89-502) Ottawa: Minister of Supply and Services Canada, 1989.
- 11 Adams OB, Nagnur DN. *Marriage, Divorce and Mortality: A Life Table Analysis for Canada and Regions* (Statistics Canada, Catalogue 84-536) Ottawa: Minister of Supply and Services Canada, 1988.
- 12 Dumas J, Bélanger A, Smith G. *Report on the Demographic Situation in Canada, 1996* (Statistics Canada, Catalogue 91-209-XPE) Ottawa: Minister of Industry, 1997.
- 13 Statistics Canada. *Public Use Micro Data File, Documentation and User Guide, 1995 General Social Survey, Cycle 10: Family* (Catalogue 12M0010GPE) Ottawa: Minister of Industry, 1997.



Data Releases

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

Heart disease and stroke in Canada, 1997

Heart disease and stroke in Canada outlines the patterns of risk factors, mortality and disability attributable to cardiovascular disease, as well as its impact on the health care system. This document is a collaborative effort of the Heart and Stroke Foundation of Canada, the Laboratory Centre for Disease Control, Health Canada and Statistics Canada, and was prepared by the Heart and Stroke Foundation of Saskatchewan Epidemiology Unit at the University of Saskatchewan. The 1997 edition includes a section on "Stroke in Canada: Strategies," as well as current trends in stroke mortality and disability. For more information, contact The Heart and Stroke Foundation of Canada (613-241-4361) or Cyril Nair (613-951-8387), Health Statistics Division, Statistics Canada.

1994/95 Hospital morbidity

During fiscal year 1994/95, there were 3.5 million discharges from general and allied special hospitals in the provinces and territories. These discharges accounted for 37.5 million days of hospital care, with an average length of stay of 11 days. (These figures refer to inpatient events only and exclude newborns as well as patients treated on an outpatient basis in, for example, emergency wards or day surgery programs.)

Comparable trend data for 1984/85 to 1994/95 are available for the provinces only. During this period, the number of hospital discharges declined moderately by 5%, whereas the discharge rate fell by a much larger 18%, from 14,484 to 11,838 discharges per 100,000 population. At the same time, the annual number of hospital days decreased 10% from 41.5 million to 37.5 million, reflecting, to some degree, a drop in the average length of stay from 11.4 to 10.9 days.

Surgical procedures accounted for 48% of total hospital discharges in 1994/95, just slightly below the percentage (50%) in 1984/85. However,

there was a sharp 22% downturn in the surgical procedure rate from 7,281 to 5,662 surgical procedures per 100,000 population.

Declines in hospital discharge rates are due, in part, to the trend toward more frequent use of ambulatory care and day surgery. Additionally, improved treatment methods as well as new pharmaceuticals may have reduced the need for hospitalization or surgical intervention.

The 1994/95 hospital morbidity data were collected from general and allied special hospitals by the Canadian Institute for Health Information. For further information on the 1994/95 data, contact Sherry Kennedy (416-429-0477 extension 3532, or fax: 416-429-1953). The mailing address is:

Canadian Institute for Health Information
250 Ferrand Drive
P.O. Box 3900
Don Mills, Ontario
M3C 2T9

For further information on trends from 1984/85 to 1994/95, contact Ghislaine Villeneuve (613-951-1641), Health Statistics Division, Statistics Canada.

Discharge Abstract Database

The Canadian Institute for Health Information also maintains the Discharge Abstract Database (DAD), which currently covers fiscal years 1979/80 to 1996/97. The DAD is patient-specific and contains clinical, demographic and administrative data on patient discharges for acute, chronic, rehabilitation, day surgery and outpatient discharges. The DAD includes 85% of all hospital patient discharges and has proven useful in evaluating patient length of stay and resource consumption and in supporting facility-specific clinical research.

1994/95 Mental health statistics

In 1994/95 there were 211,342 discharges for mental disorders from Canadian hospitals. General hospitals accounted for the majority (84%) of these discharges, with psychiatric

hospitals making up the remaining 16%. The average length of stay in general hospitals (34 days) was much shorter than in psychiatric hospitals (271 days), which are more likely to treat long-term care patients.

Since 1984/85 the number of discharges for mental disorders has increased by 12% in general hospitals, but in psychiatric hospitals the number has fallen by 14%. However, the discharge rate has decreased in both types of hospitals. The rate for general hospitals declined just 3% from 630 to 612 discharges per 100,000 population. The decrease was much sharper (31%) in psychiatric hospitals where the rate fell from 152 to 105 discharges per 100,000 population.

The decreases in discharge rates reflect the shift in treatment strategies for the mentally ill, with more emphasis on outpatient treatment in hospitals and community clinics, as well as the transfer of long-term chronic care patients to residential care facilities.

These statistics are counts of hospital discharges of cases diagnosed as mental disorders. Discharges are counts of events, not patients, so for example, a patient admitted and discharged three times during the reporting year would be counted as three discharges.

The 1994/95 data were collected from general hospitals and psychiatric hospitals by the Canadian Institute for Health Information. For more details on the 1994/95 data, contact Sherry Kennedy (416-429-0477 extension 3532, or fax: 416-429-1953). The mailing address is:

Canadian Institute for Health Information
250 Ferrand Drive
PO Box 3900
Don Mills, Ontario
M3C 2T9

For further information on trends from 1984/85 to 1994/95, contact Ghislaine Villeneuve (613-951-1641), Health Statistics Division, Statistics Canada.

Health Indicators, 1997

Health Indicators, 1997 is an electronic database on diskette combining summary information from Workplace Injuries, Notifiable Diseases, National Health Expenditures, the Survey of Consumer Finance, and vital events such as births, stillbirths and deaths. The new edition contains more indicators from the National Population Health Survey such as job satisfaction and perceived health status.

Health Indicators is designed to meet the needs of market researchers, educators and students, special interest groups, policy developers, and program managers. As well as the health status of Canadians, the data cover health care utilization and performance.

Available on CANSIM: matrices 1001-1006, 1011-1013, 1020, 1084-1097, 4263-4282; tables 00060101-00060141 and 00060201-00060217.

The 1997 edition of *Health Indicators* (82-221-XDE, \$250.00) is now on sale. See **How to Order**. For further information, contact Deirdre Gillieson (613-951-1635, fax: 613-951-0792) 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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