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Vol. 17 No. 1

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In 2002, more than 13% of the adult population, an estimated 3.3 million Canadians, had insomnia. Insomnia tended to afflict people with painful chronic conditions or mood/anxiety disorders. Insomnia was also associated with life stress, obesity, frequent use of alcohol or cannabis, being female and low education.

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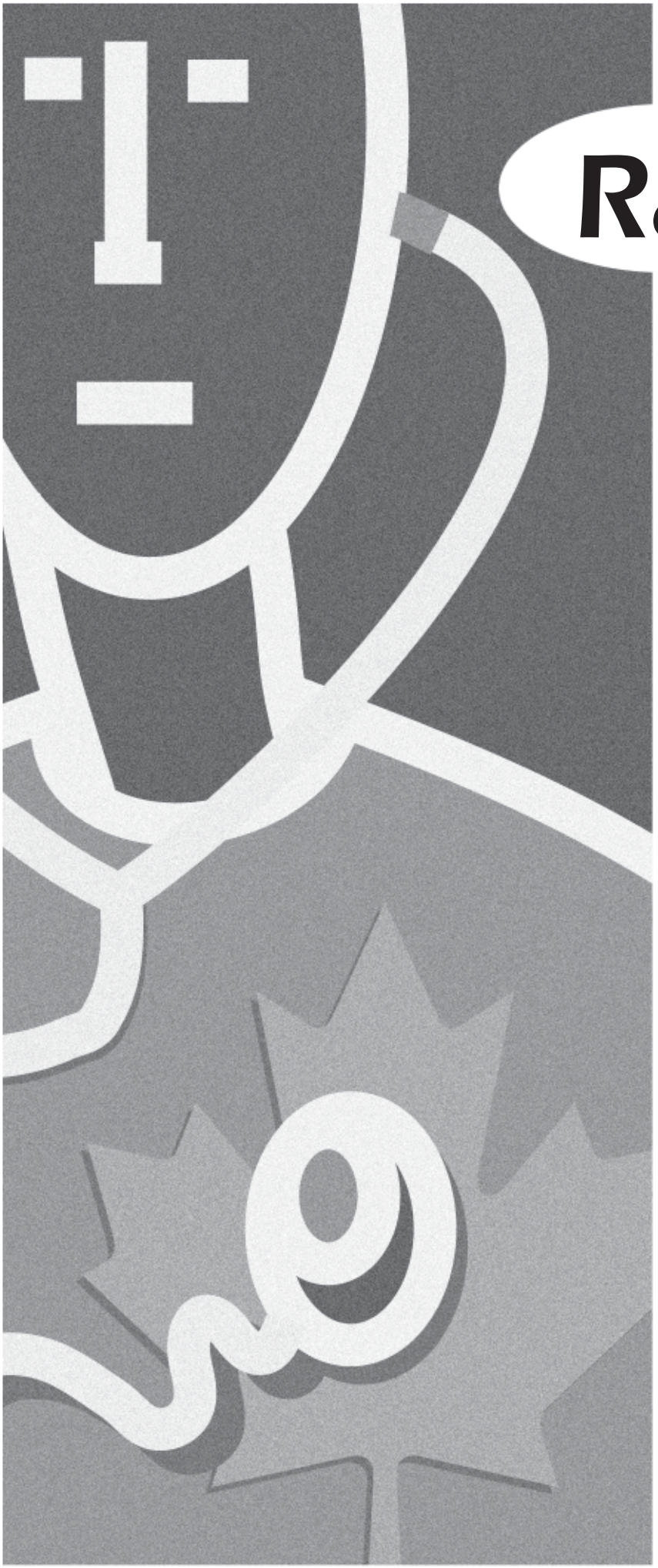

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Insomnia

Michael Tjepkema

Abstract

Objectives

This article estimates the prevalence of insomnia among Canadians aged 15 or older, and factors related to it. Associations between insomnia and coping ability, work status, two-week disability days and life dissatisfaction are analyzed.

Data sources

The data are from the 2002 Canadian Community Health Survey: Mental Health and Well-being.

Analytical techniques

Cross-tabulations were used to estimate the prevalence of insomnia by selected characteristics. Associations between these characteristics and insomnia, and between insomnia and selected negative situations, were examined in multivariate logistic regression models.

Main results

In 2002, an estimated 3.3 million Canadians (13.4% of the household population aged 15 or older) had insomnia. Factors independently associated with insomnia included painful chronic conditions, activity limitations, mood and anxiety disorders, life stress, frequent use of alcohol or cannabis, obesity, and low education. Compared with those who did not have insomnia, people with insomnia were more likely to report negataive situations such as difficulty coping and not having a job.

Keywords

sleep, sleep problems, chronic conditions, mood disorders, anxiety disorders, stress, alcohol, drug abuse, physical activity

Author

Michael Tjepkema (416-952-4620); Michael.Tjepkema@statcan.ca) is with the Health Statistics Division at Statistics Canada in the Toronto Regional Office, 25 St. Clair Avenue E., Toronto, Ontario, M4T 1M4.

For a substantial number of Canadians, a good night's sleep is an elusive and frustrating goal. Many suffer from insomnia, the most common sleep disorder.[1] Insomnia may involve difficulty falling asleep, difficulty remaining asleep, early morning awakenings or non-restorative sleep.[2-5] People with insomnia may have trouble concentrating, remembering or accomplishing daily tasks.[2,6-9] They also have a relatively high risk of accidents.[10] The economic consequences include the costs of increased use of health care services,[7,11,12] work absences, and work-related injuries.[2,13,14] Insomnia has been associated with physical and mental illnesses; however, because insomnia can be both a symptom of another condition or a disorder in itself,[15] the direction of these relationships is not always clear.[2]

Based on data from the 2002 Canadian Community Health Survey (CCHS): Mental Health and Well-being, this article presents prevalence rates of insomnia for the household population aged 15 or older (see *Methods*). Factors associated with insomnia are explored in multivariate models (see *Definitions*). Associations between insomnia and coping skills, work status, disability days and life satisfaction are examined.

Methods

Data sources

The analysis in this article is based on cycle 1.2 of the Canadian Community Health Survey (CCHS): Mental Health and Well-being, which began in May 2002 and was conducted over eight months. This cycle covered people aged 15 or older living in private dwellings in the 10 provinces. Residents of the three territories, Indian reserves, institutions, certain remote areas and Canadian Armed Forces bases, and full-time members of the Forces were excluded.

The sample was selected using the area frame designed for the Canadian Labour Force Survey. A multi-stage stratified cluster design was used to sample dwellings within this area frame. One respondent aged 15 or older was randomly selected from the sampled households. Most interviews (86%) were conducted in person; the remainder, by telephone. Proxy responses were not accepted. The responding sample consisted of 36,984 people aged 15 or older; the response rate was 77%. More detailed descriptions of the design, sample and interview procedures can be found in other reports and on the Statistics Canada Web site.[16,17]

Analytical techniques

Cross-tabulations based on data from the 2002 CCHS were used to estimate the prevalence of insomnia by age and sex.

To investigate factors associated with insomnia, correlates were selected based on the literature and on availability in the CCHS (Appendix Table A). A bivariate analysis then determined if a statistical relationship existed between each correlate and insomnia. If there was no association, the correlate was not used in the multiple logistic regression models.

This analysis used a series of six cascading multiple logistic regression models to examine insomnia in relation to an increasing array of independent variables. The first model included only socio-demographic variables. In the second, body mass index, physical activity levels, heavy weekly drinking and weekly illicit drug use were added. Shift work was added in the third model; life stress and work stress, in the fourth. The fifth model added chronic conditions and activity limitations. Mood and anxiety disorders were added in the sixth (see *Definitions*).

Separate analyses for men and women yielded similar odds ratios for independent factors. Therefore, the sexes were combined, and tests for sex interactions with each independent factor were conducted. There were no statistically significant interactions by sex, except that anxiety had higher odds for men than women, and bronchitis and "a bit" of life stress had higher odds for women than men.

To account for the effects of survey design, the variance on prevalence, on differences between prevalence rates, and on odds ratios was calculated using the bootstrap technique.[23-25]

Difficult to define

There are no standard criteria for defining insomnia.[18-20] Consequently, estimates of its prevalence vary, with each definition yielding a different figure.[5,21,22]

Insomnia may be classified by presence of a symptom (yes/no), level of severity (mild, moderate, severe), frequency (once a week, 3 to 4 times a week, etc.) and/or duration (less than a month, 6 months or longer). The most common criteria use frequency,[5] as was the case in the CCHS, which asked, "How often do you have trouble going to sleep or staying asleep?" Respondents had five choices: none of the time; a little of the time; some of the time; most of the time; all of the time. Those who answered either "most of the time" or "all of the time" were considered to have insomnia.

More than 3 million

According to the CCHS criteria, in 2002, an estimated 13.4% of the household population aged 15 or older—that is, 3.3 million Canadians—had insomnia (Chart 1). On average, they slept 6.5 hours a night, compared with 7.5 hours for those without insomnia. But many insomniacs got far less than 6.5 hours of sleep. For example, 18% of them averaged less than 5 hours a night, whereas this amount of sleep was reported by just 2% of those who did not have insomnia (Table 1).

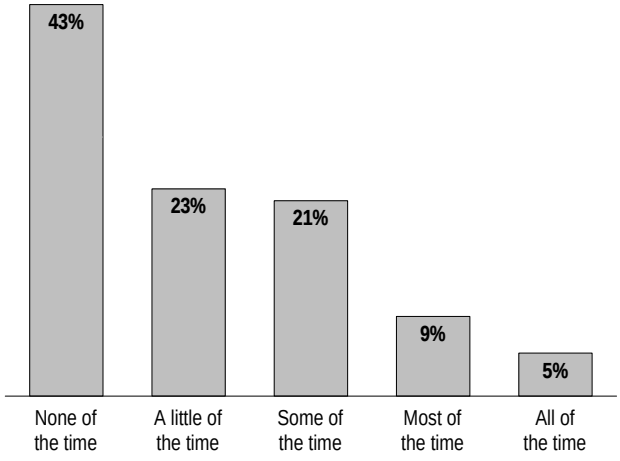
As might be anticipated, a substantial proportion of people with insomnia used sleep medication. In 2002, close to a third (29%) of them reported that they had taken sleep medication at least once in the previous 12 months. The percentage was much lower—7%—among people who did not have

insomnia. Most of the sleep medication taken by insomniacs was prescribed: 23% had used prescription medication in the past year; 6.5% had used medication that was not prescribed.

And when they did sleep, over a third (36.5%) of insomniacs often did not feel refreshed after awakening. This was far less common for people who did not have insomnia (9%).

Research has shown a long list of factors to be related to insomnia, ranging from physical and emotional disorders to demographic and socio-economic characteristics. However, many of these factors are interrelated, so what seems to be a direct association may disappear when the effects of the others are taken into account.

Chart 1
Frequency of having trouble going to or staying asleep, household population aged 15 or older, Canada excluding territories, 2002



Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*

Table 1
Percentage of people reporting selected sleep characteristics, by presence of insomnia, household population aged 15 or older, Canada excluding territories, 2002

	Insomnia	
	Yes	**No**
	%	
Hours of sleep per night		
Less than 5	17.9*	2.2
5 to < 6	19.5*	7.2
6 to < 7	26.2*	23.4
7 to < 8	20.1*	35.8
8 to < 9	11.0*	24.8
9 or more	5.3*	6.6
Took sleep medication in past 12 months	**29.0***	**7.3**
Prescribed	22.6*	4.7
Not prescribed	6.5*	2.6
Usually do not find sleep refreshing	36.5*	9.2

Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*
** Significantly different from estimate for those without insomnia ($p < 0.05$)*

Body and soul

Links between poor physical health and insomnia have repeatedly been demonstrated,[4,15,26-29] as many diseases involve pain and/or distress that can interfere with sleep. Indeed, people with each of the 13 chronic conditions considered in this analysis were more likely to report problems sleeping than were those without the conditions (Table 2). For instance, in 2002, over 20% of people with asthma, arthritis/rheumatism, back problems or diabetes reported insomnia, compared with around 12% of people who did not have these conditions.

When demographic, socio-economic, lifestyle and several psychological factors were held constant, the conditions that remained independently related to insomnia were fibromyalgia, arthritis/rheumatism, back problems, migraine, heart disease, cancer, chronic bronchitis/emphysema/chronic obstructive pulmonary disease, stomach/intestinal ulcers, and bowel disorders. On the other hand, associations between insomnia and asthma, high blood pressure, diabetes and the effects of stroke disappeared.

Even beyond chronic conditions, people who had a long-term activity limitation that affected their hearing, vision, communication, cognition or mobility were more likely to have insomnia than were those who did not have such a limitation.

Echoing earlier research,[3-5,11,26-28,30-33] the analysis of CCHS results shows mental and emotional health to be strongly associated with insomnia. Around a third of people who reported having had an anxiety or mood disorder (panic or depression, for instance) in the past year had insomnia, compared with 12% of those who did not have such disorders (Table 2). Even when the effects of socio-economic status, lifestyle and physical health were taken into account,

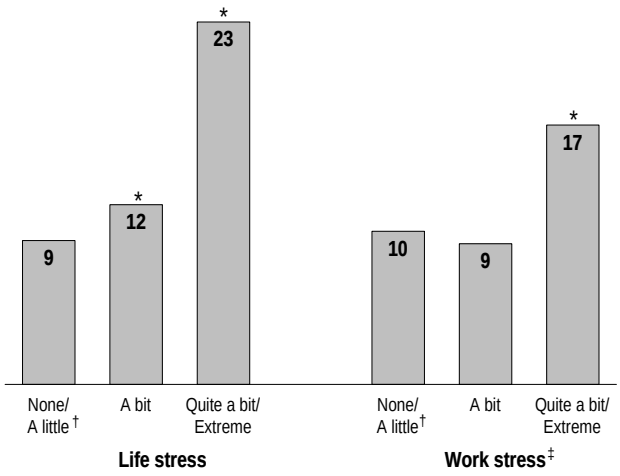
Table 2
Prevalence of and adjusted odds ratios for insomnia, by selected characteristics, household population aged 15 or older, Canada excluding territories, 2002

	%	Adjusted odds ratio	95% confidence interval
Total	**13.4**	**...**	**...**
Chronic conditions			
Asthma			
Yes	21.1*	1.2	1.0, 1.4
No†	12.7	1.0	...
Fibromyalgia			
Yes	42.3*	1.9*	1.4, 2.5
No†	13.0	1.0	...
Arthritis/Rheumatism			
Yes	23.9*	1.3*	1.1, 1.4
No†	11.1	1.0	...
Back problems			
Yes	22.6*	1.4*	1.2, 1.5
No†	11.0	1.0	...
High blood pressure			
Yes	18.9*	1.0	0.9, 1.1
No†	12.4	1.0	...
Migraine			
Yes	25.6*	1.6*	1.4, 1.8
No†	11.9	1.0	...
Diabetes			
Yes	22.4*	1.1	0.9, 1.4
No†	12.9	1.0	...
Heart disease			
Yes	26.4*	1.4*	1.2, 1.6
No†	12.6	1.0	...
Cancer			
Yes	23.3*	1.4*	1.1, 1.7
No†	13.2	1.0	...
Stomach/Intestinal ulcers			
Yes	27.9*	1.3*	1.1, 1.6
No†	12.8	1.0	...
Effects of stroke			
Yes	28.6*	1.1	0.8, 1.5
No†	13.2	1.0	...
Bowel disorders			
Yes	27.8*	1.4*	1.2, 1.7
No†	13.0	1.0	...
Chronic bronchitis/Emphysema/ Chronic obstructive pulmonary disease			
Yes	29.4*	1.2*	1.0, 1.5
No†	12.7	1.0	...
Activity limitation			
Never†	9.3	1.0	...
Sometimes	18.5*	1.5*	1.3, 1.7
Often	29.9*	2.1*	1.8, 2.4
Anxiety disorder (past year)			
Yes	31.0*	1.5*	1.3, 1.8
No†	12.2	1.0	...
Mood disorder (past year)			
Yes	36.5*	2.1*	1.8, 2.5
No†	12.0	1.0	...
Life stress			
None/A little†	9.2	1.0	...
A bit	11.5*	1.4*	1.2, 1.6
Quite at bit/Extreme	23.2*	2.3*	2.0, 2.7
Work stress‡			
None/A little†	9.8	1.0	...
A bit	9.0	0.8*	0.7, 0.9
Quite at bit/Extreme	16.6*	1.1	0.9, 1.3
Shift work‡			
Yes	13.0*	1.3*	1.1, 1.4
No	10.9	1.0	...
At least weekly			
Heavy drinking			
Yes	16.2*	1.5*	1.2, 1.8
No	13.2	1.0	...
Illicit drug use			
Yes, cannabis only	18.4*	1.5*	1.1, 1.9
Yes, other illicit drugs (with or without cannabis)	15.9	1.1	0.7, 1.7
No†	13.2	1.0	...
Body mass index			
Underweight	12.9	0.9	0.7, 1.2
Normal weight†	12.1	1.0	...
Overweight	13.1	1.0	0.9, 1.1
Obese class I	16.7*	1.1	1.0, 1.3
Obese class II/III	22.4*	1.4*	1.1, 1.7
Leisure-time physical activity level			
High	12.0*	1.0	0.9, 1.1
Moderate	11.8*	0.9*	0.8, 1.0
Low	13.8*	1.0	0.9, 1.1
Sedentary†	15.6	1.0	...
Sex			
Men†	11.6	1.0	...
Women	15.1*	1.1*	1.0, 1.2
Age group			
15-24†	10.0	1.0	...
25-34	9.7	1.0	0.8, 1.2
35-44	12.6*	1.2	0.9, 1.4
45-54	15.9*	1.4*	1.2, 1.8
55-64	15.7*	1.3*	1.0, 1.6
65-74	15.6*	1.2	0.9, 1.5
75+	19.7*	1.2	0.9, 1.5
Marital status			
Married†	12.9	1.0	...
Widowed	21.8*	1.2*	1.0, 1.4
Separated/Divorced	18.9*	1.1	0.9, 1.3
Single	11.1*	1.0	0.8, 1.1
Education			
Less than secondary graduation	17.3*	1.4*	1.2, 1.6
Secondary graduation	13.7*	1.2*	1.1, 1.4
Some postsecondary	12.1	1.0	0.9, 1.2
Postsecondary graduation†	11.3	1.0	...
Household income			
Lowest	19.9*	1.1	0.9, 1.3
Lower-middle	15.5*	1.1	0.9, 1.2
Upper-middle	12.3*	1.0	0.9, 1.1
Highest†	11.0	1.0	...

Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*
Notes: *A "missing" category for household income, body mass index and anxiety disorder was included in the model to maximize sample size, but the odds ratios are not shown. A "not applicable" category for shift work and work stress was included in the model, but the odds ratios are not shown.*
† Reference category
‡ Respondents aged 15 to 75 who were currently working or who had worked at job or business in past 12 months
** Significantly different from estimate for reference category ($p < 0.05$)*
··· Not applicable

the odds that people with anxiety or mood disorders would have difficulty sleeping were significantly high.

Chart 2
Percentage of people reporting insomnia, by stress level, household population aged 15 or older, Canada excluding territories, 2002



Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*
† Reference category
‡ Respondents aged 15 to 75 who were currently working or who had worked at job or business in past 12 months
**Significantly different from estimate for reference category (p < 0.05)*

Table 3
Percentage of people reporting insomnia, by main source of stress, household population aged 15 or older, Canada excluding territories, 2002

Main source of stress	%
Overall prevalence of insomnia	**13.4**
Own physical health problem	31.2*
Death of loved one	24.6*E
Own emotional/mental health problem	24.0*
Personal and family's safety	16.6
Other personal/family responsibilities	16.4*
Personal relationships	15.8*
Caring for others	15.6
Employment status (unemployment)	14.6
Financial situation	14.5
Health of family members	14.4
Other	14.2
Caring for own children	12.1
Own work situation	11.9*
Time pressures/Not enough time	8.1*
None	8.0*
School	7.5*

Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*
** Significantly different from overall insomnia rate (p < 0.05)*
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Life stress

Close to a quarter (23%) of people who described most of their days as being either "quite a bit" or "extremely" stressful reported insomnia; this was more than twice the percentage for people who reported little or no life stress. Even among those whose days were "a bit" stressful, the prevalence of insomnia was elevated (Chart 2). Consistent with earlier research,[28,34] these differences persisted when physical and emotional/mental health, along with demographic, socio-economic and lifestyle factors, were taken into account (Table 2).

The type of stress, not simply the presence of stress, also made a difference. People whose main source of stress was a physical health problem, the death of a loved one, an emotional/mental health problem, personal/family responsibilities or a personal relationship had high rates of insomnia, compared with the overall rate (Table 3).

Work stress

At first glance, work stress also seems to be associated with insomnia: 17% of employed people aged 15 to 75 who said that most days at work were "quite a bit" or "extremely" stressful reported insomnia, compared with fewer than 10% with no or little work stress (Chart 2). However, when the effects of all the other variables were taken into account, these relationships did not hold. In fact, people reporting "a bit" of work stress actually had low odds of insomnia, compared with those with little or no work stress (Table 2).

While work stress was not associated with insomnia, an individual's work schedule was.[35,36] Employed people who had a non-regular shift were more likely to report insomnia than were those who worked during the day. Even when the other factors were held constant, the odds that shift workers would report insomnia were high, compared with other workers (Table 2).

Alcohol and drugs

Alcohol, which is a sedating agent, can aid the onset of sleep. However, it can also lead to increased arousal later in the sleep cycle, and with continued

Definitions

Insomnia was determined in the Canadian Community Health Survey (CCHS) by the question, "How often do you have trouble going to sleep or staying asleep?" Five response categories were read to the respondent: none of the time; a little of the time; some of the time; most of the time; all of the time. Respondents who answered either "most of the time" or "all of the time" were considered to have insomnia.

To calculate *usual hours of sleep per night*, respondents were asked, "How long do you usually spend sleeping each night?" Interviewers were instructed not to include time spent resting. Twelve one-hour response categories from "less than 2 hours" to "12 hours or more" were available for interviewers to record respondents' answers. To calculate average hours of sleep, each response category was assigned the midpoint value. For example, respondents who answered "6 to less than 7 hours" were given a value of 6.5 hours. Those who answered "less than 2 hours" were given a value of 1.5, and respondents who answered "12 or more hours" were given a value of 12.5 hours.

Use of *sleep medication* was measured by asking, "In the past 12 months, did you take any medication to help you sleep (such as Imovane, Nytol or Starnoc)?" Follow-up questions asked if the medication was taken under the supervision of a health professional and who prescribed the medication.

Respondents were considered to find *sleep not refreshing* if they answered "none of the time" or "a little of the time" to the question, "How often do you find your sleep refreshing?"

To measure *chronic conditions*, individuals were asked about conditions that had lasted or were expected to last six months or longer and that had been diagnosed by a health professional. Interviewers read a list of conditions. Those used in this analysis are: asthma; fibromyalgia; arthritis or rheumatism; back problems; high blood pressure; migraine; diabetes; heart disease; cancer; stomach or intestinal ulcers; effects of stroke; bowel disorder; chronic bronchitis, emphysema or chronic obstructive pulmonary disease.

To determine *activity limitation*, interviewers asked: "Do you have any difficulty hearing, seeing, communicating, walking, climbing stairs, bending, learning or doing any similar activities?" and "Does a long-term physical condition or mental condition or health problem reduce the amount or the kind of activity you can do: at home, at work, or at school or other activities (e.g., transportation or leisure)?"

Anxiety disorder in the past year consisted of at least one of the following: panic disorder, social anxiety disorder, or agoraphobia. *Mood disorder* in the past year consisted of either a major depressive episode and/or mania (bipolar 1). For a complete list of questions and algorithms used by the CCHS to measure these disorders, based on the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV)*,[18] see the Annex in the 2004 annual *Health Reports* supplement. Questions and a general description are available at the following URL: http://www.statcan.ca/english/freepub/82-617-XIE/index.htm.

Life stress was determined by asking, "Thinking about the amount of stress in your life, would you say that most days are: not at all stressful, not very stressful, a bit stressful, quite a bit stressful, extremely stressful?" For this analysis, "not at all stressful" and "not very stressful" were combined, and "quite a bit stressful" and "extremely stressful" were combined.

Main source of stress was determined by asking, "Thinking about stress in your day-to-day life, what would you say is the most important thing contributing to feelings of stress you may have?" Interviewers could choose from 16 categories to record the response.

Work stress was determined by asking respondents aged 15 to 75 who were working or who had worked at a job or business during the previous year about their main job: "Would you say that most days at work were: not at all stressful, not very stressful, a bit stressful, quite a bit stressful, or extremely stressful?" For this analysis, "not at all stressful" and "not very stressful" were combined, as were "quite a bit stressful" and "extremely stressful."

Shift work was determined by asking respondents aged 15 to 75 who were working or who had worked at a job or business during the previous year: "Which of the following best describes the hours you usually work(ed) at this job?" Eight responses were possible: regular daytime schedule or shift; regular evening shift; regular night shift; rotating shift; split shift; on call; irregular schedule; or other. Shift work was defined as anything but a regular daytime schedule.

Respondents were asked if they had had a drink of beer, wine, liquor or any other alcoholic beverage in the past year. They were told that a "drink" meant one bottle or can of beer or glass of draft, one glass of wine or wine cooler, or one drink or cocktail with 1 1/2 ounces of liquor. *Heavy drinking* was determined by asking respondents how often in the past 12 months they had had 5 or more drinks on one occasion. Those who answered at least weekly were considered to be *frequent heavy drinkers*.

Respondents were asked if they had used an *illicit drug* in the past 12 months. Those who said "yes" were asked how often: less than once a month, 1 to 3 times a month, once a week, more than once a week, or every day. This question was asked for each of the following drugs: marijuana, cannabis or hashish; cocaine or crack; speed (amphetamines); ecstasy (MDMA) or similar drugs; hallucinogens, PCP or LSD (acid); glue, gasoline or other solvents (sniffing); and heroin. Respondents were assigned a frequency for the drug they used most often. Therefore, someone who used cannabis (but no other illicit drugs) once a week was assigned a frequency of at least weekly cannabis only use. Someone who used cannabis once a week and cocaine 1 to 3 times a month was assigned a frequency of at least weekly use of other illicit drugs (with or without cannabis).

Weight was defined in terms of *body mass index* (BMI), which was calculated by dividing weight in kilograms by the square of height in metres. BMI was grouped into five categories: underweight (less than 18.5), normal weight (18.5 to 24.9), overweight (25.0 to 29.9), obese class I (30.0 to 34.9), and obese class II/III (35.0 or more).

Definitions - concluded

To derive *leisure-time physical activity level*, respondents' energy expenditure (EE) was estimated for each activity they engaged in during leisure time. This was calculated by multiplying the number of times a respondent engaged in an activity over a 12-month period by the average duration in hours and by the energy cost of the activity (kilocalories expended per kilogram of body weight per hour of activity). To calculate average daily EE for the activity, the estimate was divided by 365. This calculation was repeated for all leisure-time activities reported, and the resulting estimates were summed to provide an aggregate average daily EE. The frequency (or regularity) of physical activity was based on the number of times in the previous three months that respondents had participated in a physical activity that lasted more than 15 minutes: regular (12 or more times per month) or irregular (11 or fewer times per month). The following *physical activity categories* were defined:

- High – high (3 or more kcal/kg/day) energy expenditure during regular physical activity
- Moderate – medium (1.5 to 2.9 kcal/kg/day) energy expenditure during regular physical activity
- Light – low (less than 1.5 kcal/kg/day) energy expenditure during regular physical activity
- Sedentary – irregular physical activity regardless of energy expenditure

Seven *age groups* were used: 15 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, 65 to 74, and 75 or older.

Four categories were used for *marital status*: married or living common-law; widowed; divorced or separated; and never married.

Respondents were grouped into four *education* categories based on the highest level attained: less than secondary graduation, secondary graduation, some postsecondary, and postsecondary graduation.

Household income was based on the number of people in the household and total household income from all sources in the 12 months before the interview.

Household income group	People in household	Total household income
Lowest	1 or 2	Less than $15,000
	3 or 4	Less than $20,000
	5 or more	Less than $30,000
Lower-middle	1 or 2	$15,000 to $29,999
	3 or 4	$20,000 to $39,999
	5 or more	$30,000 to $59,999
Upper-middle	1 or 2	$30,000 to $59,999
	3 or 4	$40,000 to $79,999
	5 or more	$60,000 to $79,999
Highest	1 or 2	$60,000 or more
	3 or more	$80,000 or more

Respondents' ability to handle *day-to-day demands* was determined by the question, "In general, how would you rate your ability to handle day-to-day demands in your life, for example, handling work, family and volunteer responsibilities? Would you say your ability is: excellent, very good, good, fair, poor?"

Respondents were also asked about *unexpected and difficult problems*: "In general, how would you rate your ability to handle unexpected and difficult problems, for example, a family or personal crisis? Would you say your ability is: excellent, very good, good, fair, poor?"

Respondents aged 25 to 54 were classified as *not currently employed* if they did not work in the week before the interview and did not have a job or business from which they were absent.

Two-week disability was measured in terms of bed-days and "cut-down" days over the previous two weeks. Respondents were asked about days they stayed in bed because of illness or injury (including nights in hospital) and about days they cut down normal activities because of illness or injury.

Dissatisfaction with life was based on the question, "How satisfied are you with your life in general: very satisfied, satisfied, neither satisfied nor dissatisfied, dissatisfied, very dissatisfied?" The last two categories were used to classify respondents as being dissatisfied with life.

use, its benefit as a sleep aid is reduced.[37] According to the results of the CCHS, 16% of frequent heavy drinkers reported insomnia, compared with 13% of those who were not frequent heavy drinkers. This association persisted, even allowing for the effects of the other factors (Table 2). The association may result from prolonged and excessive self-medication of sleep problems with alcohol, or from chronic heavy alcohol consumption affecting the brain's regulation of sleep or being associated with co-morbid physical and psychiatric conditions that can contribute to insomnia.[38]

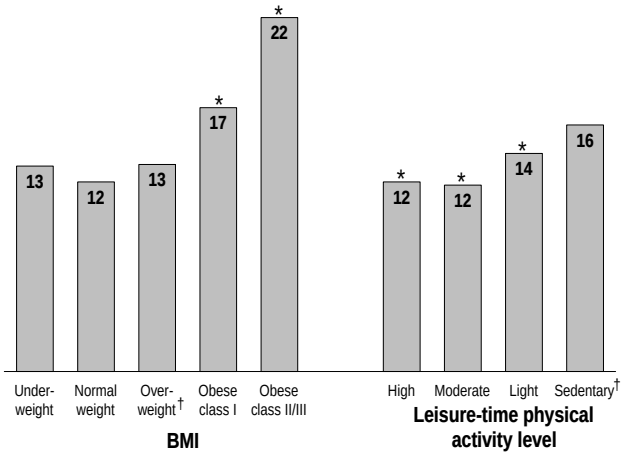
About one in five (18%) people who used cannabis, but no other illicit drugs, at least once a week reported insomnia, significantly higher than the 13% reported by those who did not use illicit drugs or used them less frequently. When the other factors were taken into account, frequent cannabis users still had significantly high odds of reporting insomnia (Table 2).

Obesity and physical activity

High proportions of people who were obese suffered from insomnia. And the heavier they were, the more likely they were to have trouble sleeping.[29] According to the CCHS, 17% of people whose weight put them in obese class I and 22% who were in obese class II/III reported insomnia; this compared with 12% of people in the normal weight range (Chart 3). But when the effects of the other factors were controlled, only those in obese class II/III had high odds of insomnia (Table 2). This association might be a by-product of sleep apnea, which is related to obesity and is also a risk factor for insomnia,[39,40] but was not measured in the CCHS (see *Limitations*).

Physical activity is generally thought to be beneficial to sleep by contributing to psychological well-being, muscle relaxation, thermal effects and energy conservation, although little epidemiological evidence supports this claim.[32,41-43] Some studies have found exercise to be a modest and fragile protective factor,[32-34,44,45] or not to be associated with insomnia,[28] depending on the definitions, age group and study design. CCHS results show that physically active people had a lower prevalence of insomnia than did sedentary individuals (Chart 3). But when the effects of the other factors were taken into account, only people who were moderately active had low odds of insomnia, compared with sedentary individuals; neither high nor light physical activity was significantly associated with insomnia (Table 2).

Chart 3
Percentage of people reporting insomnia, by body mass index (BMI) and leisure-time physical activity level, household population aged 15 or older, Canada excluding territories, 2002



Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*
† Reference category
**Significantly different from estimate for reference category (p < 0.05)*

Limitations

Epidemiological research contains no standard definition of insomnia.[5] Therefore, while the prevalence reported in this analysis (13.4%) falls within a range of previously reported figures,[5] comparisons with other findings should be cautious, because of differences in question wording, response categories and collection methods.

Important factors known to be associated with insomnia were not available in the Canadian Community Health Survey (CCHS): past history of insomnia, other sleep disorders such as sleep apnea, sleep hygiene habits, and nicotine and caffeine intake.[5,15] Because these variables could not be included in the multivariate models, CCHS results may overestimate associations between some factors and insomnia.

This analysis did not differentiate between acute, sub-acute and chronic states of insomnia. Primary, secondary and self-induced insomnia could not be disentangled, nor was it possible to distinguish between incident and prevalent cases. Therefore, important differences between these types of insomnia, which have been shown to have different risks and outcomes, could not be ascertained.[4,8,46]

CCHS results were based on self-reports; answers were not validated by an independent source. For example, self-reported weight and height are known to underestimate the prevalence of overweight and obesity.[47-49]

The measure of energy expenditure likely underestimated respondents' total physical activity because it did not account for activity at work or while doing household chores.

Because the analysis of CCHS data is cross-sectional, associations between variables can be examined at only one point in time. Neither causality nor the temporal ordering of events can be inferred. For instance, whether a chronic condition is a cause or a result of insomnia, or if both share a common pathology, is not clear.[2] As well, the literature suggests that the relationship between insomnia and emotional problems is bi-directional, and that there may be a common source.[13,15,50] And whether frequent heavy drinking and drug use led to insomnia or insomnia led to frequent heavy drinking and drug use could not be determined.

A problem of middle age

It is hardly surprising that painful physical conditions, mental and emotional problems, stress, and alcohol and drug use are related to insomnia. Even obesity and lack of physical activity might logically be associated with the inability to get a good night's sleep. But beyond these factors, a number of less obvious relationships exist.

The prevalence of insomnia rises with age, doubling from 10% at ages 15 to 24 to almost 20% at age 75 or older (Table 2). It has been suggested that, with age, circadian rhythms change and melatonin (a hormone involved in the sleep-wake cycle) declines.[8,28,51] But old age is associated with chronic conditions, and once chronic conditions were taken into account, seniors no longer had high odds of insomnia (Table 2, Appendix Table B Model 5). This suggests that the elevated prevalence of insomnia among seniors is largely attributable to poorer health.

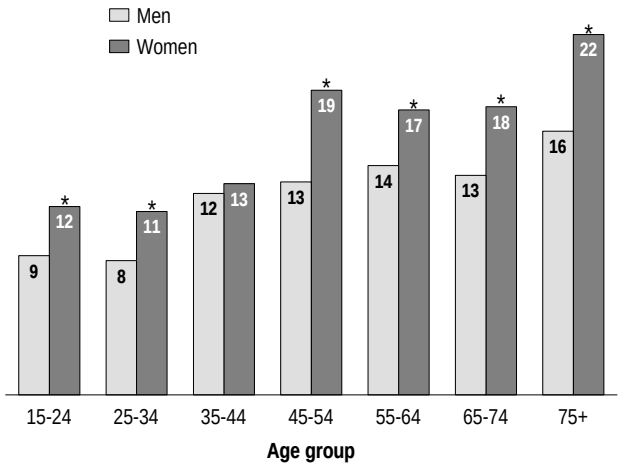
By contrast, even allowing for the effects of the other factors, middle-aged people (45 to 54 or 55 to 64) had significantly high odds of reporting insomnia, compared with 15- to 24-year-olds. Such results were unexpected, as in other research,[15,28] this association between age and insomnia disappeared when the influence of physical and mental health was controlled. However, one study did find the highest prevalence of insomnia among 55- to 64-year-olds.[12] Furthermore, it is possible that variables not available in the CCHS are driving the association between insomnia and middle-age.

Women at risk

Women were more likely than men to report insomnia: 15% versus 12% (Table 2). This discrepancy prevailed among all age groups except 35-to-44, among whom rates were similar (Chart 4).

The higher prevalence of insomnia among women may, in part, be due to hormonal changes related to menstruation, pregnancy and menopause.[52,53] As well, in general, psychiatric illness tends to be more common among women than men.[54] Yet even when physical and mental health were controlled for, the odds that women would report insomnia were still slightly higher than men's (Table 2, Appendix Table B Model 6). This suggests that women's elevated insomnia rates are related, in part, to factors other than health, lifestyle and socio-economic differences between men and women.

Chart 4
Percentage of people reporting insomnia, by sex and age group, household population aged 15 or older, Canada excluding territories, 2002



Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*
**Significantly different from estimate for men (p < 0.05)*

Marital status, education and income

According to the 2002 CCHS, 22% of widowers and 19% of separated/divorced people had trouble sleeping, both percentages significantly above the figure for married people (13%). Among those who had never been married, the prevalence of insomnia was lower (11%), mirroring other research.[12,55] Since marital status and age are related, the high insomnia rates among widowers and divorced/separated individuals might be a result of differences that reflect age, not marital status. Indeed, when adjustments were made to control for chronic conditions, the associations between marital status and insomnia disappeared for every group except those who were widowed (Table 2, Appendix Table B Model 5). The persistence of the relationship between widowhood and insomnia may be tied to one of the forms of stress that was also a factor in insomnia: death of a loved one.

People with little formal education or lower income have been shown to have a higher prevalence of insomnia.[28,55] CCHS results support these findings in that those whose education had not advanced beyond high school graduation and residents of low-income households were more likely to report insomnia than were postsecondary graduates or residents of high-income households. When the other factors were taken into account, people with secondary graduation or less still had high odds of reporting insomnia, but the association with household income was no longer statistically significant (Table 2, Appendix Table B Model 6).

Negative associations

With cross-sectional data such as those from the CCHS, it is not possible to trace causal pathways between insomnia and particular outcomes. Nonetheless, a number of significant associations did emerge from the analysis.

Substantial numbers of insomniacs had trouble coping. While 12% rated their ability to handle day-to-day demands, such as work and family responsibilities, as fair or poor, the corresponding figure for people who did not have insomnia was 4% (Table 4). An even larger share of insomniacs—17%—rated their ability to deal with unexpected and difficult problems, such as a family or personal crises, as fair or poor, compared with 8.5% of those who did not have insomnia.

Table 4
Percentage of people reporting selected problems, by presence of insomnia, household population aged 15 or older, Canada excluding territories, 2002

	Insomnia	
	Yes	No
	%	
Fair/Poor ability to handle:		
Day-to-day demands	11.8*	4.3
Unexpected problems	16.7*	8.5
Not currently employed†	25.2*	15.7
Two-week disability	23.8*	11.7
Dissatisfied with life	12.2*	3.4

Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*
† Respondents aged 25 to 54
** Significantly different from estimate for those without insomnia ($p < 0.05$)*

A quarter (25%) of insomniacs aged 25 to 54 were not employed; the figure was 16% for their contemporaries who did not have trouble sleeping. The large percentage of insomniacs who did not have a job may, to some extent, explain the previously noted lack of association between insomnia and work stress.

People with insomnia were also more likely to report having had days in the previous two weeks when they were confined to bed or had to cut back on their normal activities: 24% versus 12%.

And more globally, the percentage of insomniacs who reported that they were dissatisfied or very dissatisfied with their life (12%) was much higher than the figure for those who did not have insomnia (4%).

Of course, many factors besides insomnia are related to coping, employment, illness and general dissatisfaction with life. For instance, since people with insomnia are in poorer physical health than those without insomnia, their greater likelihood of reporting a disability day or not having a job may be a result of their health, not necessarily insomnia. Nonetheless, when chronic conditions and the other health, lifestyle and socio-economic variables were taken into account, those with insomnia still had significantly higher odds of reporting a disability day and not working (Appendix Table C). The other differences, too, persisted when the effects of the demographic, socioeconomic, lifestyle and physical and mental health factors were considered.

Concluding remarks

In 2002, 13% of Canadian adults (more than three million individuals) met the criteria for insomnia; that is, they had difficulty going to sleep or staying asleep most or all of the time.

Physical and psychological problems can interfere with sleep. Painful conditions such as arthritis, migraine and fibromyalgia were associated with insomnia, as were anxiety and mood disorders and stressful life events. As well, alcohol and cannabis use were significant factors. Obesity, too, was related to having problems with sleep.

On the other hand, moderate physical activity and a bit of work stress were protective. The lack of a

positive association between work stress and insomnia may reflect the relatively large proportion of insomniacs who do not work.

Some less obvious factors were associated with insomnia. When physical and mental health status, lifestyle, and demographic and socio-economic variables were controlled for, being female, middle-aged, widowed, and having a low education were significantly related to insomnia.

Even allowing for a series of physical, mental, lifestyle and socio-economic factors, insomnia was related to some adverse situations. Relatively large percentages of insomniacs had difficulty coping with day-to-day demands and unexpected problems. They were also more likely than other people to have had a recent disability day and to express overall dissatisfaction with life. As well, a significantly large proportion of people in the prime working age range who suffered from insomnia were not employed. ●

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Appendix

Table A
Distribution of selected characteristics, household population aged 15 or older, Canada excluding territories, 2002

	Sample size	Estimated population	
		'000	%
Insomnia			
Yes	5,612	3,346	13.4
No	31,364	21,647	86.6
Sex			
Men	16,771	12,284	49.2
Women	20,205	12,708	50.8
Age group			
15-24	5,673	4,136	16.6
25-34	5,770	4,054	16.2
35-44	7,042	5,453	21.8
45-54	5,702	4,442	17.8
55-64	5,055	3,181	12.7
65-74	4,112	2,191	8.8
75+	3,622	1,534	6.1
Marital status			
Married	19,181	15,409	61.7
Widowed	3,814	1,363	5.5
Separated/Divorced	4,152	1,843	7.4
Single	9,797	6,351	25.4
Missing	32	28[E]	0.1[E]
Education			
Less than secondary graduation	10,589	6,306	25.2
Secondary graduation	6,496	4,692	18.8
Some postsecondary	3,049	2,078	8.3
Postsecondary graduation	16,612	11,678	46.7
Missing	230	240	1.0
Household income			
Lowest	4,953	2,299	9.2
Lower-middle	8,079	4,737	19.0
Upper-middle	11,781	8,099	32.4
Highest	8,716	7,482	29.9
Not stated	3,447	2,376	9.5
Body mass index			
Underweight	1,061	763	3.1
Normal weight	16,991	11,995	48.0
Overweight	11,980	7,984	31.9
Obese class I	4,476	2,819	11.3
Obese class II/III	1,714	1,003	4.0
Missing	753	429	1.7
Leisure-time physical activity level			
High	9,515	6,526	26.1
Moderate	9,622	6,500	26.0
Low	5,557	3,651	14.6
Sedentary	12,277	8,314	33.3
Missing	5	F	F
At least weekly heavy drinking			
Yes	2,491	1,630	6.5
No	34,303	23,252	93.0
Missing	182	111	0.4
At least weekly illicit drug use			
Cannabis only	1,019	669	2.7
Any illicit drug	456	321	1.3
No illicit drug used on a weekly basis	35,391	23,927	95.7
Missing	110	75	0.3
Shift work			
Yes	7,915	5,675	22.7
No	16,245	12,254	49.0
Not applicable	12,607	6,894	27.6
Missing	209	170	0.7
Life stress			
None/A little	14,246	9,090	36.4
A bit	14,702	10,121	40.5
Quite a bit/Extreme	8,014	5,778	23.1
Missing	14	4[E]	0.0[E]
Work stress			
None/A little	7,522	5,397	21.6
A bit	9,624	6,979	27.9
Quite a bit/Extreme	6,863	5,479	21.9
Not applicable	12,743	6,989	28.0
Missing	224	149	0.6
Activity limitation			
Never	24,447	17,637	70.6
Sometimes	6,899	4,233	16.9
Often	5,587	3,094	12.4
Missing	43	29[E]	0.1[E]
Chronic conditions			
Asthma			
Yes	3,357	2,131	8.5
No	33,616	22,861	91.5
Missing	3	F	F
Fibromyalgia			
Yes	595	366	1.5
No	36,369	24,622	98.5
Missing	12	F	F
Arthritis/Rheumatism			
Yes	8,244	4,383	17.5
No	28,714	20,601	82.4
Missing	18	9[E]	0.0[E]
Back problems			
Yes	8,396	5,212	20.9
No	28,573	19,778	79.1
Missing	7	F	F
High blood pressure			
Yes	6,640	3,702	14.8
No	30,303	21,273	85.1
Missing	33	18[E]	0.1[E]
Migraine			
Yes	3,984	2,680	10.7
No	32,985	22,309	89.3
Missing	7	F	F
Diabetes			
Yes	2,130	1,210	4.8
No	34,835	23,778	95.1
Missing	11	F	F
Heart disease			
Yes	2,717	1,359	5.4
No	34,236	23,622	94.5
Missing	23	12[E]	0.0[E]
Cancer			
Yes	863	492	2.0
No	36,102	24,497	98.0
Missing	11	F	F
Stomach/Intestinal ulcers			
Yes	1,700	1,033	4.1
No	35,251	23,950	95.8
Missing	25	10[E]	0.0[E]
Effects of stroke			
Yes	521	251	1.0
No	36,446	24,739	99.0
Missing	9	F	F
Bowel disorder			
Yes	1,236	697	2.8
No	35,726	24,291	97.2
Missing	14	F	F
Chronic bronchitis/Emphysema/Chronic obstructive pulmonary disease			
Yes	1,783	977	3.9
No	35,164	23,996	96.0
Missing	29	20[E]	0.1[E]
Anxiety disorder (past year)			
Yes	1,803	1,162	4.6
No	34,065	23,199	92.8
Missing	1,108	632	2.5
Mood disorder (past year)			
Yes	2,122	1,309	5.2
No	34,556	23,524	94.1
Missing	298	159	0.6

Data source: *2002 Canadian Community Health Survey: Mental Health and Well-being*
Note: *Eight respondents did not answer the question on insomnia.*
E Coefficient of variation between 16.6% and 33.3% (interpret with caution)
F Coefficient of variation greater than 33.3% (suppressed because of extreme sampling variability)

Table B
Adjusted odds ratios relating selected characteristics to insomnia, household population aged 15 or older, Canada excluding territories, 2002

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Sex												
Men†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Women	1.3*	1.2,1.4	1.4*	1.2,1.5	1.3*	1.2,1.5	1.3*	1.1,1.4	1.1*	1.0,1.3	1.1*	1.0,1.2
Age group												
15-24†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
25-34	1.2	1.0,1.4	1.1	0.9,1.3	1.2	1.0,1.4	1.1	0.9,1.3	1.0	0.8,1.2	1.0	0.8,1.2
35-44	1.5*	1.3,1.8	1.5*	1.2,1.8	1.5*	1.2,1.8	1.4*	1.1,1.7	1.2	0.9,1.4	1.2	0.9,1.4
45-54	2.0*	1.6,2.4	1.9*	1.6,2.3	1.9*	1.6,2.4	1.8*	1.5,2.2	1.4*	1.1,1.7	1.4*	1.2,1.8
55-64	1.8*	1.5,2.2	1.8*	1.5,2.2	1.7*	1.4,2.1	1.8*	1.4,2.2	1.2	1.0,1.5	1.3*	1.0,1.6
65-74	1.6*	1.3,2.0	1.6*	1.3,2.0	1.4*	1.1,1.7	1.5*	1.2,1.9	1.1	0.8,1.4	1.2	0.9,1.5
75+	1.8*	1.5,2.3	1.9*	1.6,2.4	1.6*	1.2,2.0	1.9*	1.5,2.3	1.0	0.8,1.4	1.2	0.9,1.5
Marital status												
Married†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Widowed	1.2*	1.1,1.4	1.2*	1.0,1.4	1.2*	1.0,1.4	1.2*	1.0,1.4	1.2*	1.0,1.5	1.2*	1.0,1.4
Separated/Divorced	1.4*	1.2,1.5	1.3*	1.2,1.5	1.3*	1.2,1.5	1.2*	1.1,1.4	1.2	1.0,1.3	1.1	0.9,1.3
Single	1.0	0.9,1.2	1.0	0.9,1.2	1.0	0.9,1.2	1.0	0.9,1.2	1.0	0.9,1.2	1.0	0.8,1.1
Education												
Less than secondary graduation	1.5*	1.3,1.7	1.4*	1.3,1.6	1.4*	1.2,1.5	1.4*	1.3,1.6	1.4*	1.2,1.6	1.4*	1.2,1.6
Secondary graduation	1.2*	1.1,1.4	1.2*	1.0,1.3	1.2*	1.0,1.3	1.2*	1.1,1.4	1.2*	1.1,1.4	1.2*	1.1,1.4
Some postsecondary	1.2	1.0,1.4	1.1	0.9,1.3	1.1	0.9,1.3	1.1	1.0,1.3	1.1	0.9,1.3	1.0	0.9,1.2
Postsecondary graduation†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Household income												
Lowest	1.6*	1.4,1.9	1.5*	1.3,1.8	1.4*	1.2,1.6	1.3*	1.1,1.5	1.1	1.0,1.3	1.1	0.9,1.3
Lower-middle	1.3*	1.1,1.4	1.2*	1.1,1.4	1.2*	1.0,1.3	1.2*	1.0,1.3	1.1	0.9,1.3	1.1	0.9,1.2
Upper-middle	1.1	0.9,1.2	1.0	0.9,1.2	1.0	0.9,1.1	1.0	0.9,1.2	1.0	0.9,1.1	1.0	0.9,1.1
Highest†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Body mass index												
Underweight			1.0	0.8,1.3	1.0	0.8,1.3	1.0	0.8,1.3	1.0	0.8,1.3	0.9	0.7,1.2
Normal weight†			1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Overweight			1.1	1.0,1.2	1.1	1.0,1.2	1.1	1.0,1.2	1.0	0.9,1.1	1.0	0.9,1.1
Obese class I			1.4*	1.2,1.6	1.4*	1.2,1.6	1.3*	1.2,1.6	1.2	1.0,1.4	1.1	1.0,1.3
Obese class II/III			1.9*	1.6,2.3	1.9*	1.6,2.3	1.9*	1.5,2.3	1.4*	1.1,1.7	1.4*	1.1,1.7
Leisure-time physical activity level												
High			0.9*	0.8,1.0	0.9*	0.8,1.0	0.9	0.8,1.0	1.0	0.9,1.1	1.0	0.9,1.1
Moderate			0.8*	0.7,0.9	0.8*	0.7,0.9	0.8*	0.7,0.9	0.9*	0.8,1.0	0.9*	0.8,1.0
Low			0.9	0.8,1.0	0.9	0.8,1.0	0.9	0.8,1.0	1.0	0.8,1.1	1.0	0.9,1.1
Sedentary†			1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
At least weekly												
Heavy drinking			1.4*	1.2,1.7	1.5*	1.2,1.8	1.5*	1.2,1.8	1.5*	1.2,1.8	1.5*	1.2,1.8
Cannabis only			1.8*	1.4,2.2	1.8*	1.4,2.2	1.8*	1.4,2.3	1.5*	1.2,2.0	1.5*	1.1,1.9
Other illicit drug (with or without cannabis)			1.6*	1.1,2.3	1.6*	1.1,2.3	1.4	0.9,2.1	1.3	0.8,1.9	1.1	0.7,1.7
Shift work‡					1.2*	1.1,1.4	1.3*	1.1,1.5	1.3*	1.1,1.4	1.3*	1.1,1.4
Life stress												
None/A little†							1.0	...	1.0	...	1.0	...
A bit							1.6*	1.4,1.8	1.4*	1.3,1.6	1.4*	1.2,1.6
Quite at bit/Extreme							3.5*	3.0,3.9	2.6*	2.3,3.0	2.3*	2.0,2.7
Work stress‡												
None/A little†							1.0	...	1.0	...	1.0	...
A bit							0.7*	0.6,0.9	0.8*	0.7,0.9	0.8*	0.7,0.9
Quite at bit/Extreme							1.0	0.9,1.2	1.0	0.9,1.3	1.1	0.9,1.3
Activity limitation												
Never†									1.0	...	1.0	...
Sometimes									1.5*	1.4,1.8	1.5*	1.3,1.7
Often									2.3*	2.0,2.6	2.1*	1.8,2.4

	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Chronic conditions												
Asthma									1.2	1.0,1.4	1.2	1.0,1.4
Fibromyalgia									1.9*	1.4,2.6	1.9*	1.4,2.5
Arthritis/Rheumatism									1.3*	1.1,1.4	1.3*	1.1,1.4
Back problems									1.4*	1.2,1.5	1.4*	1.2,1.5
High blood pressure									1.0	0.9,1.1	1.0	0.9,1.1
Migraine									1.7*	1.5,1.9	1.6*	1.4,1.8
Diabetes									1.1	0.9,1.4	1.1	0.9,1.4
Heart disease									1.4*	1.2,1.6	1.4*	1.2,1.6
Cancer									1.4*	1.1,1.7	1.4*	1.1,1.7
Stomach/Intestinal ulcers									1.4*	1.1,1.7	1.3*	1.1,1.6
Effects of stroke									1.1	0.8,1.5	1.1	0.8,1.5
Bowel disorders									1.4*	1.2,1.7	1.4*	1.2,1.7
Chronic bronchitis/ Emphysema/Chronic obstructive pulmonary disease									1.3*	1.1,1.6	1.2*	1.0,1.5
Anxiety disorder (past year)											1.5*	1.3,1.8
Mood disorder (past year)											2.1*	1.8,2.5
Model information												
Sample size	36,730		36,459		36,276		36,043		35,867		35,617	
Sample with insomnia	5,568		5,524		5,495		5,461		5,413		5,352	
Records dropped because of missing values	254		525		708		941		1,117		1,367	

***Data source**: 2002 Canadian Community Health Survey: Mental Health and Well-being*
***Note:** A "missing" category for household income, body mass index and anxiety disorder was included in the models to maximize sample size, but the respective odds ratios are not shown. A "not applicable" category for shift work and work stress was included in the models, but the respective odds ratios are not shown.*
† Reference category. When not noted, reference category is absence of characteristic; for example, reference category for asthma is no reported diagnosis of asthma.
‡ Respondents aged 15 to 75 who were currently working or who had worked at job or who had business in past 12 months
** Significantly different from estimate for reference category ($p < 0.05$)*
··· Not applicable

Table C
Adjusted odds ratios relating insomnia and selected characteristics to selected problems, household population aged 15 or older, Canada excluding territories, 2002

	Fair/Poor ability to handle day-to-day demands		Fair/Poor ability to handle unexpected problems		Not currently employed‡		At least one disability day in past two weeks		Dissatisfied with life	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Insomnia										
Yes	1.2*	1.0, 1.4	1.2*	1.0, 1.3	1.3*	1.1, 1.6	1.3*	1.2, 1.5	1.6*	1.3, 1.8
No	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Sex										
Men†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Women	0.8*	0.7, 0.9	1.2*	1.0, 1.3	2.4*	2.1, 2.8	1.2*	1.1, 1.4	0.8*	0.7, 0.9
Age group										
15-24†	1.0	...	1.0	...			1.0	...	1.0	...
25-34	0.6*	0.5, 0.8	0.9	0.7, 1.0	1.0	...	0.9	0.7, 1.0	1.8*	1.4, 2.4
35-44	0.8	0.6, 1.0	0.9	0.7, 1.1	0.7*	0.6, 0.8	0.7*	0.6, 0.8	1.9*	1.4, 2.5
45-54	0.7*	0.5, 0.9	0.9	0.7, 1.1	0.8*	0.7, 0.9	0.5*	0.4, 0.6	2.0*	1.5, 2.7
55-64	0.7*	0.5, 0.9	1.0	0.8, 1.3	...	...	0.4*	0.4, 0.5	2.0*	1.4, 2.8
65-74	0.7*	0.5, 0.9	0.8	0.6, 1.1	...	...	0.3*	0.3, 0.4	1.0	0.7, 1.6
75+	0.8	0.5, 1.1	0.9	0.7, 1.2	...	...	0.3*	0.2, 0.4	1.0	0.7, 1.6
Marital status										
Married†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Widowed	0.9	0.7, 1.2	0.7*	0.6, 0.9	0.8	0.3, 2.6	1.1	1.0, 1.4	1.4*	1.0, 1.9
Separated/Divorced	1.3	1.0, 1.7	1.0	0.8, 1.2	0.6*	0.5, 0.7	1.1	1.0, 1.3	2.5*	2.0, 3.1
Single	1.2	1.0, 1.4	1.2*	1.0, 1.3	1.0	0.8, 1.2	1.1	1.0, 1.3	2.3*	1.8, 2.8
Education										
Less than secondary graduation	1.7*	1.4, 2.0	1.7*	1.5, 2.0	1.4*	1.2, 1.7	0.9	0.8, 1.0	1.0	0.8, 1.2
Secondary graduation	1.2	1.0, 1.5	1.2*	1.0, 1.4	1.0	0.8, 1.2	1.0	0.9, 1.2	1.0	0.8, 1.3
Some postsecondary	1.4*	1.0, 1.8	1.2	1.0, 1.5	1.2	0.9, 1.6	1.1	0.9, 1.3	1.2	0.9, 1.6
Postsecondary graduation†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Household income										
Lowest	1.7*	1.3, 2.3	1.6*	1.3, 2.0	9.1*	7.0,11.9	0.8*	0.7, 0.9	1.7*	1.2, 2.2
Lower-middle	1.3*	1.0, 1.6	1.5*	1.2, 1.7	3.4*	2.7, 4.2	0.8*	0.7, 0.9	1.6*	1.2, 2.1
Upper-middle	1.1	0.9, 1.4	1.3*	1.1, 1.5	1.7*	1.4, 2.1	0.8*	0.7, 0.9	1.1	0.9, 1.4
Highest†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Body mass index										
Underweight	1.3	0.9, 1.8	1.0	0.8, 1.3	1.0	0.7, 1.4	1.0	0.8, 1.2	1.0	0.7, 1.6
Normal weight†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
Overweight	1.0	0.8, 1.1	0.9	0.8, 1.0	1.0	0.8, 1.1	1.0	0.9, 1.1	0.9	0.8, 1.1
Obese class I	0.9	0.7, 1.2	0.8*	0.7, 1.0	0.8*	0.7, 1.0	1.1	1.0, 1.3	0.9	0.8, 1.2
Obese class II/III	0.9	0.7, 1.3	0.7*	0.5, 0.9	0.9	0.7, 1.2	1.2	1.0, 1.4	0.9	0.6, 1.2
Leisure-time physical activity level										
High	0.6*	0.5, 0.7	0.7*	0.6, 0.8	1.3*	1.1, 1.5	1.2*	1.1, 1.4	0.6*	0.5, 0.7
Moderate	0.8*	0.6, 0.9	0.9	0.8, 1.0	1.2	1.0, 1.4	1.0	0.9, 1.2	0.7*	0.5, 0.8
Low	0.7*	0.6, 0.9	1.0	0.8, 1.2	1.3*	1.1, 1.6	0.9	0.8, 1.1	0.8*	0.6, 1.0
Sedentary†	1.0	...	1.0	...	1.0	...	1.0	...	1.0	...
At least weekly										
Heavy drinking	1.1	0.8, 1.5	1.3*	1.0, 1.6	0.9	0.7, 1.3	0.9	0.8, 1.1	1.2	0.9, 1.7
Cannabis only	1.1	0.7, 1.7	1.1	0.8, 1.5	1.5*	1.0, 2.3	1.1	0.9, 1.5	1.5*	1.0, 2.1
Other illicit drug (with or without cannabis)	0.8	0.4, 1.3	1.0	0.7, 1.5	1.5	0.8, 2.7	1.6*	1.1, 2.5	1.4	0.9, 2.4

	Fair/Poor ability to handle day-to-day demands		Fair/Poor ability to handle unexpected problems		Not currently employed‡		At least one disability day in past two weeks		Dissatisfied with life	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Shift work§	1.0	0.8, 1.2	1.0	0.9, 1.2	0.3*	0.3, 0.4	1.0	0.9, 1.2	1.2*	1.0, 1.5
Life stress										
None/A little†	1.0	…	1.0	…	1.0	…	1.0	…	1.0	…
A bit	1.8*	1.5, 2.2	1.6*	1.4, 1.9	1.3*	1.1, 1.5	1.2*	1.0, 1.3	2.0*	1.6, 2.5
Quite at bit/Extreme	3.0*	2.4, 3.7	2.2*	1.9, 2.6	1.1	0.8, 1.3	1.2*	1.1, 1.4	5.2*	4.1, 6.6
Work stress§										
None/A little†	1.0	…	1.0	…	1.0	…	1.0	…	1.0	…
A bit	1.1	0.8, 1.5	1.0	0.8, 1.2	0.1*	0.1, 0.1	1.0	0.9, 1.2	1.1	0.8, 1.3
Quite at bit/Extreme	1.0	0.8, 1.4	0.9	0.8, 1.1	0.1*	0.1, 0.2	1.1	0.9, 1.3	1.0	0.8, 1.4
Activity limitation										
Never†	1.0	…	1.0	…	1.0	…	1.0	…	1.0	…
Sometimes	1.2*	1.0, 1.5	1.4*	1.2, 1.7	1.4*	1.1, 1.6	1.9*	1.7, 2.2	1.5*	1.2, 1.8
Often	2.0*	1.6, 2.4	1.6*	1.3, 1.9	2.1*	1.7, 2.6	4.0*	3.5, 4.6	2.0*	1.6, 2.4
Chronic conditions										
Asthma	1.0	0.8, 1.2	1.1	0.9, 1.3	0.9	0.7, 1.2	1.1	0.9, 1.2	1.0	0.7, 1.3
Fibromyalgia	1.5	1.0, 2.2	1.0	0.7, 1.3	1.2	0.8, 1.8	1.8*	1.3, 2.3	1.4	0.9, 2.1
Arthritis/Rheumatism	1.2	1.0, 1.5	1.1	1.0, 1.3	1.2	1.0, 1.5	1.3*	1.2, 1.5	0.9	0.8, 1.1
Back problems	1.1	0.9, 1.3	1.1	0.9, 1.2	1.0	0.8, 1.2	1.5*	1.3, 1.6	1.3*	1.1, 1.5
High blood pressure	1.1	0.9, 1.4	1.0	0.8, 1.2	1.2*	1.0, 1.5	1.1	1.0, 1.3	1.0	0.8, 1.2
Migraine	1.1	0.9, 1.3	1.0	0.9, 1.2	1.0	0.8, 1.2	1.3*	1.2, 1.5	1.1	0.9, 1.4
Diabetes	1.0	0.8, 1.4	1.2	1.0, 1.5	1.3	1.0, 1.9	1.0	0.8, 1.2	1.4*	1.0, 1.9
Heart disease	1.0	0.8, 1.3	1.0	0.8, 1.3	1.2	0.9, 1.7	1.4*	1.2, 1.7	1.0	0.8, 1.3
Cancer	1.0	0.6, 1.5	0.8	0.6, 1.1	1.2	0.7, 2.1	1.5*	1.2, 2.0	1.2	0.8, 1.9
Stomach/Intestinal ulcers	1.1	0.8, 1.6	1.3*	1.0, 1.7	1.2	0.9, 1.7	1.3*	1.1, 1.5	1.0	0.7, 1.4
Effects of stroke	1.8*	1.2, 2.7	1.2	0.8, 1.7	1.7	0.8, 3.7	1.6*	1.2, 2.2	1.7*	1.0, 2.7
Bowel disorders	1.3	0.9, 1.7	1.3*	1.0, 1.6	1.1	0.7, 1.5	1.7*	1.4, 2.1	0.8	0.6, 1.2
Chronic bronchitis/ Emphysema/Chronic obstructive pulmonary disease	1.2	0.9, 1.5	1.0	0.8, 1.2	1.6	0.9, 2.6	1.4*	1.2, 1.7	1.1	0.8, 1.5
Anxiety disorder (past year)	2.4*	1.9, 3.0	2.2*	1.8, 2.6	1.4*	1.1, 1.9	1.2*	1.0, 1.5	1.8*	1.4, 2.3
Mood disorder (past year)	3.2*	2.6, 4.0	2.7*	2.3, 3.2	1.2	0.9, 1.5	1.5*	1.3, 1.8	3.2*	2.6, 4.0
Model information										
Sample size	35,511		35,545		17,883		35,589		35,614	
Sample with outcome	2,119		3,627		3,275		5,142		1,928	
Records dropped because of missing values	1,473		1,439		636		1,395		1,370	

***Data source**: 2002 Canadian Community Health Survey: Mental Health and Well-being*
***Notes:** A "missing" category for household income, body mass index and anxiety disorder was included in the models to maximize sample size, but the respective odds ratios are not shown. A "not applicable" category for shift work and work stress was included in the models, but the respective odds ratios are not shown.*
† Reference category. When not noted, reference category is absence of characteristic; for example, reference category for asthma is no reported diagnosis of asthma.
‡ Respondents aged 25 to 54
§ Respondents aged 15 to 75 who were currently working or who had worked at job or business in past 12 months
** Significantly different from estimate for reference category ($p < 0.05$)*
… Not applicable


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Body mass and dependency

Kathryn Wilkins and Margaret de Groh

Abstract

Objectives

The relationship between body mass index (BMI) category and dependency in men and women aged 45 or older is examined cross-sectionally and prospectively.

Data sources

Data are from the 2003 Canadian Community Health Survey and the 1994/95 through 2002/03 National Population Health Survey, household populations.

Analytical techniques

Cross-sectional data were used to produce weighted frequencies, cross-tabulations and multiple logistic regression models to estimate the prevalence of dependency and its relationship to BMI category. Associations between BMI and dependency two years later were also explored. Models were adjusted for potential confounders.

Main results

The prevalence of dependency was nearly the same among those who were underweight as among those in obese class III—the highest level of obesity. Even when the effects of potential confounders were controlled, underweight and obese people faced higher odds of co-existing dependency, compared with those in the normal BMI range. Obesity was also predictive of subsequent dependency.

Keywords

activities of daily living (ADL), instrumental activities of daily living (IADL), body mass index, chronic illness, independent living, longitudinal studies

Authors

Kathryn Wilkins (613-951-1769; Kathryn.Wilkins@statcan.ca) is with the Health Statistics Division at Statistics Canada, Ottawa, Ontario, K1A 0T6. Margaret de Groh (613-957-1786; Margaret_de_Groh@phac-aspc.gc.ca) is with the Chronic Disease Prevention Division of the Centre for Chronic Disease Prevention and Control at the Public Health Agency of Canada, Ottawa, Ontario, K1A 0K9.

As efforts to understand the factors that influence the quality of life of middle-aged and older adults gain importance,[1] the influence of weight on functional status has emerged as an area of study in the "epidemiology of disability." Cross-sectional and prospective studies have indicated that individuals at the extremes of the body mass index (BMI) ranges are far more likely to experience physical disability than are those in the "normal" BMI category.[2-5] However, findings about the role of excess weight and other risk factors on functional limitation are inconsistent. Only about half of longitudinal studies of chronic conditions in relation to future functional limitation have found a significant relationship with obesity, although the variety of measures and analytical approaches used may account for the discrepant findings.[6]

This article provides a detailed examination of the association between BMI category and dependency (see *Analytical techniques, Data sources* and *Limitations*). Estimates are presented for the Canadian household population aged 45 or older. Because other studies have found women to be at consistently greater risk than men of functional decline over time, and that obesity seems to have a greater impact on women,[5,7-10] sex-specific analyses were conducted.

Analytical techniques

Cross-sectional analysis: Based on data from the 2003 Canadian Community Health Survey (CCHS) (cycle 2.1), frequencies, cross-tabulations and multiple logistic regression models were produced using data weighted to the 2003 Canadian population. The bootstrap technique, which accounts for the design effects of the survey, was used to calculate variance.[11-13] Statistical significance was established as $p < 0.05$.

Multiple logistic regression modelling was used to examine associations between BMI categories and dependency, while controlling for confounding factors. Models were sex-specific. In addition to BMI, variables entered into regression models were selected based on findings from the literature and their availability in the survey. To distinguish variables having an indirect effect on dependency from those exerting a more direct influence, multiple logistic regression models were fitted hierarchically.[5] Variables were entered sequentially into four models (Appendix Tables A and B), as follows:

Model	Control variables
1	Age (continuous), education, main source of income, and living arrangements.
2	Variables in Model 1 *and* BMI category, smoking status, and leisure-time physical activity level.
3	Variables in Models 1 and 2 *and* respiratory disease and cancer.
4	Variables in Models 1, 2, 3 *and* high blood pressure, heart disease, diabetes and arthritis.

A variable for pain, based on sub-sample data (see *Data sources*), was also included in a separate model relating dependency to BMI level (see Table 3).

Longitudinal analysis: National Population Health Survey (NPHS) respondents were included in the analysis if they were at least 45 years old at the time of any of the cycle 1 to 4 survey interviews; provided data on their weight and height and their ability to perform personal and instrumental activities of daily living (ADL/IADL) in at least one survey interview, and data on ADL/IADL in the subsequent interview; and indicated at the time of the first of these interviews that they did not need the help of another person with these activities.

The longitudinal analysis was conducted using pooling of repeated observations, combined with logistic regression. Data on dependency were considered in two-cycle intervals (roughly corresponding to two-year periods, based on interview dates): 1994/95 to 1996/97 (cycle 1 to 2); 1996/97 to 1998/99 (cycle 2 to 3), 1998/99 to 2000/01 (cycle 3 to 4) and 2000/01 to 2002/03 (cycle 4 to 5). The first cycle in each two-cycle interval served as the baseline for the study of incident dependency; each eligible respondent was thus considered as many as four times. Respondents who were not dependent in the first cycle of the interval were re-assessed in the next cycle. For example, respondents who reported no need for assistance in cycle 1, but who were institutionalized or reported the need for assistance in cycle 2, were categorized as having become dependent. Similarly, respondents who had been categorized as not dependent in cycle 2 were included for assessment of dependency status in cycle 3. Respondents categorized as dependent in cycle 2, and then not dependent in cycle 3, were assessed again at cycle 4; respondents who were not dependent in cycle 4 were assessed at cycle 5. Thus an individual respondent could potentially contribute two counts of incident dependency—one in cycle 2 or 3, and one in cycle 4 or 5.

Multiple logistic regression analysis was used on the pooled set of observations to model the odds of a new (within a two-year interval) need for assistance or institutionalization in a long-term care facility, relative to BMI category at baseline, while controlling for the effects of other influences on this relationship. Variables to control for potential confounding included age, main source of income, level of education, living arrangements (alone or with others), chronic disease (cancer, respiratory disease), smoking and level of leisure-time physical activity.

The literature on the effects of obesity advises caution in controlling for risk factors or health problems that arise from obesity. Inclusion in multivariate models of conditions that may be intermediaries in the causal pathway from obesity to ADL/IADL dependency may mask the full effects of obesity.[14,15] Therefore, chronic conditions that were strongly positively related to BMI in preliminary analysis (high blood pressure, diabetes, arthritis), or otherwise known to be related to obesity (heart disease), were added to the multivariate models only as a final step.

All independent variables were based on data from cycles 1 through 4. For the models, the value of each independent variable was that reported in the first of two consecutive interviews, and the value of the dependent variable (incident dependency) was that reported in the second of these interviews.

Weighted data were used for all analyses. Coefficients of variation on estimates of proportion and differences between proportions and odds ratios were calculated using the bootstrap technique, which accounts for survey design effects.[11-13]

Data sources

Canadian Community Health Survey (CCHS): Cross-sectional analysis of data was based on cycle 2.1 of the CCHS, which was conducted between January and December 2003. The CCHS is a general health survey that collects cross-sectional information about the health of Canadians every two years. It covers the non-institutionalized household population aged 12 or older in all provinces and territories, except regular members of the Canadian Armed Forces and residents of Indian reserves, Canadian Forces bases, and some remote areas. The overall response rate was 80.6%; the total sample size was 135,573, of whom 69,492 were 45 or older. The cross-sectional analyses (except those involving pain) were based on data from respondents in this sample. Because of non-response to individual questionnaire items, the actual number of respondents used in each tabulation or model varied. For example, data for the following number of respondents were missing: 165 for dependency; 1,859 for body mass index (BMI); and 5,705 for main source of income.

Questions on pain are part of the Health Utility Index (HUI). In 2003, the HUI was designated a "sub-sample" module; at the national level it was administered to a randomly selected subset of respondents. The health regions in Newfoundland and Labrador, Prince Edward Island, Nova Scotia, New Brunswick and Québec opted to have this module administered to all respondents in their provinces. Of these respondents and the subset in the remaining provinces and territories, 35,466 were 45 or older. In this sub-sample, data were missing on dependency (58), BMI (871) and main source of income (5,243).

A description of the CCHS methodology is available in a published report.[16]

National Population Health Survey (NPHS): Longitudinal analysis was based on data from the first five NPHS cycles, 1994/95 through 2002/03. Since 1994/95, the NPHS has collected information about the health of the Canadian population every two years. It covers household and institutional residents in all provinces and territories, except persons on Indian reserves, on Canadian Forces bases and in some remote areas.

In 1994/95, 20,095 individuals were selected for the longitudinal panel. Of these, 17,276 agreed to participate, for a response rate of 86.0%. The response rates for subsequent cycles, based on these 17,276 respondents, were: 92.8% in cycle 2 (1996/97); 88.2% in cycle 3 (1998/99); 84.8% in cycle 4 (2000/01); and 80.6% in cycle 5 (2002/03).

More detailed descriptions of the NPHS design, sample and interview procedures can be found in published reports.[17,18]

The 2002/03 NPHS cycle 5 longitudinal "square" master file was used for this analysis. This file contains records for all longitudinal respondents in the household component (n = 17,276) whether or not they provided information for all five cycles (that is, individuals selected for the longitudinal sample for whom information is available for cycle 1). The longitudinal analysis in this study was based on data for respondents meeting the following criteria: aged 45 or older in cycle 1, 2, 3, or 4; not dependent (see *Definitions*) in at least one of these cycles and provided data on height and weight in that same cycle; and provided data on their dependency status in the following cycle.

Full descriptions of the CCHS and the National Population Health Survey are available on the Statistics Canada Web site @ http://www.statcan.ca/english/sdds/0031t.htm.

The relationship between level of BMI and co-existing dependency was studied using cross-sectional data from the 2003 Canadian Community Health Survey (CCHS). Then, the association between BMI and subsequent dependency was assessed with longitudinal data from the 1994/95 through 2002/03 National Population Health Survey (NPHS). For both analyses, several potentially confounding characteristics were taken into account, including age, socio-economic status, living arrangements, health and behavioural risk factors, chronic diseases weakly or not related to obesity, chronic conditions strongly related to obesity, and chronic pain (see *Definitions).*

Women at higher risk

For this analysis, CCHS respondents were considered to be dependent if they needed help with

personal care activities such as washing and dressing and/or with other daily activities including housework or meal preparation (see *Definitions*). In 2003, women aged 45 or older were twice as likely (16.8%) as their male counterparts (8.2%) to report dependency (Chart 1, Table 1). Women's need for help was especially pronounced for tasks involving transportation or physical effort, notably running errands or getting to appointments and doing everyday housework. Further analysis was undertaken to investigate the extent to which these differences may have resulted from gender roles or the older age distribution of women. Yet even at younger ages, women were more likely than men to report the need for help with meal preparation—traditionally a more "female" task (data not shown). The gap in dependency between the sexes persisted even when controlling for the effects of age, socio-economic status, BMI, health and lifestyle risk factors, and chronic disease. In fact, the odds of dependency for women were twice the corresponding odds for men (data not shown).

Table 1
Percentage of people who were dependent, by task and sex, household population aged 45 or older, Canada, 2003

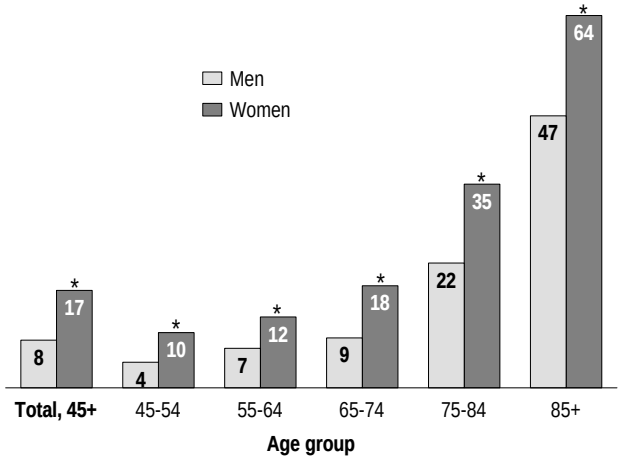
	Men	Women
	%	
Total (any task)	**8.2**	**16.8***
Everyday housework	5.9	12.3*
Getting to appointments/ Running errands	5.6	12.1*
Preparing meals	3.6	5.2*
Personal care (e.g., washing, dressing, eating)	2.6	3.3*
Moving about in house	1.8	2.3*

Data source: *2003 Canadian Community Health Survey*
** Significantly higher than estimate for men (p < 0.05)*

Underweight, obesity linked to dependence

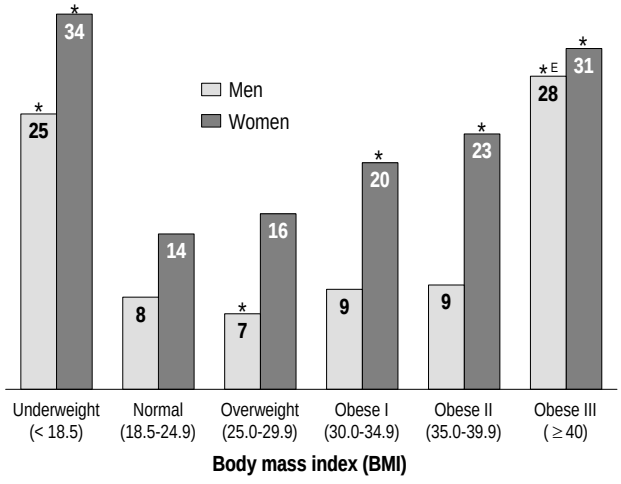
Adults at both BMI extremes—underweight and obese class III—were significantly more likely than those in the "normal" category to be dependent (Chart 2). This "J-" or "U-shaped" relationship has been noted in other reports.[19-22] One-quarter of

Chart 1
Percentage of people who were dependent, by age group and sex, household population aged 45 or older, Canada, 2003



Data source: *2003 Canadian Community Health Survey*
Note: *Compared with estimates for 45-to-54 age group, all other age group estimates are statistically different within each sex (p < 0.05).*
**Significantly higher than estimate for men (p < 0.05)*

Chart 2
Percentage of people who were dependent, by body mass index and sex, household population aged 45 or older, Canada, 2003



Data source: *2003 Canadian Community Health Survey*
**Significantly different from estimate for same sex in "normal" BMI category (p < 0.05)*
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

underweight men (24.8%) and one-third of underweight women (33.8%) aged 45 or older were dependent. People with a BMI of 40 or more were categorized as obese class III; similar proportions of men (28.2%) and women (30.7%) in this group were dependent. For women, the relationship between obesity and dependency increased steadily with the level of obesity. The obesity–dependency relationship was weaker for men; only those in the class III category were more likely to be dependent than were men in the normal BMI range.

Relationships persist

The relationships between BMI level and dependency persisted when the potential influences of age, socio-economic status and health-related behaviours were taken into account simultaneously (Appendix Tables A and B, Models 1 and 2). At the low end of the BMI range, the odds of dependency for underweight men and women were about twice those for each sex in the normal BMI category. Other research has attributed such a relationship to the likelihood of underlying illness in underweight individuals.[1] Although this study of CCHS data took numerous chronic conditions into account, the possibility of underweight indicating frailty or compromised health remains.

As expected, controlling for the effects of cancer and respiratory disease (conditions not necessarily related to BMI) had little effect on the strength of the association between BMI and dependency (Appendix Tables A and B, Model 3).

The literature on the effects of obesity advises caution in controlling for risk factors or health problems that arise from obesity. Including conditions that may be intermediaries in the causal pathway from obesity to ADL/IADL dependency in multivariate models may mask the full effects of obesity.[14,15] Therefore, chronic conditions that were strongly positively related to BMI in preliminary analysis, or that are otherwise known to be related to obesity, were added to the multivariate models only as a final step. When the potential effects of several obesity-related conditions—high blood pressure, heart disease, diabetes and arthritis—were also taken into account, the associations between BMI and dependency were somewhat weakened (Appendix Tables A and B, Model 4; Table 2). In fact, only at the extremes of the BMI categories, underweight and obese class III, did the odds of dependency among men remain significantly elevated.

For women, the relationships between BMI and dependency were similar to those for men, but with

Table 2
Adjusted odds ratios relating BMI category and other selected characteristics to dependency, by sex, household population aged 45 or older, Canada, 2003

	Men		Women	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Age (continuous)	1.0*	1.0, 1.0	1.0*	1.0, 1.1
Socio-economic factors				
Less than secondary graduation	1.2	1.0, 1.3	1.0	0.9, 1.1
Secondary graduation or more†	1.0	...	1.0	...
Main source of income is social assistance‡	1.9*	1.6, 2.3	1.3*	1.1, 1.4
Lives alone‡	1.5*	1.3, 1.7	0.9	0.9, 1.0
Body mass index (BMI)				
Underweight (< 18.5)	2.0*	1.3, 3.2	1.9*	1.4, 2.6
Normal (18.5-24.9)‡	1.0	...	1.0	...
Overweight (25.0-29.9)	0.9	0.7, 1.0	1.0	0.9, 1.1
Obese class I (30.0-34.9)	1.1	0.9, 1.4	1.2*	1.0, 1.4
Obese class II (35.9-39.9)	1.0	0.7, 1.4	1.6*	1.2, 2.0
Obese class III (≥ 40)	3.6*	2.0, 6.6	2.3*	1.6, 3.2
Smoking status				
Smoker	1.4*	1.1, 1.6	1.3*	1.2, 1.6
Non-smoker†	1.0	...	1.0	...
Leisure-time physical activity				
Inactive	2.6*	2.1, 3.3	2.4*	2.1, 2.9
Moderate	1.2	0.9, 1.6	1.1	0.9, 1.3
Active†	1.0	...	1.0	...
Chronic conditions				
Respiratory disease‡	2.2*	1.8, 2.6	2.1*	1.8, 2.5
Cancer‡	2.1*	1.7, 2.7	2.2*	1.7, 2.9
Obesity-related chronic conditions				
High blood pressure‡	1.2*	1.0, 1.4	1.1	1.0, 1.2
Heart disease‡	1.9*	1.6, 2.2	2.1*	1.8, 2.4
Diabetes‡	1.6*	1.3, 2.0	1.7*	1.4, 2.0
Arthritis‡	2.3*	2.0, 2.7	2.4*	2.1, 2.6

Data source: *2003 Canadian Community Health Survey*
Notes: *Models are based on weighted data from records for 28,880 men and 37,783 women who provided information on mobility function. Variables for "missing" BMI and source of income were included in the models to maximize sample size, but the odds ratios are not shown. Because of rounding, some odds ratios with 1.0 as the lower confidence interval are statistically significant.*
† Reference category
‡ Reference category is absence of condition; for example, reference category for cancer is no reported diagnosis of cancer.
** Significantly different from estimate for reference category (p < 0.05)*
··· Not applicable

Definitions

Data from the 2003 Canadian Community Health Survey (CCHS) were used to calculate prevalence estimates of *dependency*. Respondents were categorized as *dependent* if they answered "yes" to at least one of the following questions**:** "Because of any physical condition or mental condition or health problem, do you need the help of another person with:

- preparing meals?"
- getting to appointments and running errands such as shopping for groceries?"
- doing everyday housework?"
- personal care such as washing, dressing, eating or taking medication?"
- moving about inside the house?"

Respondents who answered "no" to all these questions were not considered to be dependent. Those with records that showed data missing for all questions, or with "no" responses to some questions and missing responses to any other(s), were excluded from this analysis.

Data from the 1994/95 through 2002/03 National Population Health Survey (cycles 1 through 5, NPHS) were used to examine incident dependency in relation to BMI category. For the longitudinal analysis, dependency was defined as a "yes" response to any of the preceding questions (with minor differences in wording, the same questions were used by both the CCHS and the NPHS), or a respondent's move from the household population into a long-term care facility.

Body mass index (BMI) is a measure of weight adjusted for height, calculated by dividing weight in kilograms by height in metres squared. BMI categories were defined using the standards adopted by Health Canada:

- underweight: < 18.5
- normal: 18.5 to 24.9
- overweight: 25.0 to 29.9
- obese class I: 30.0 to 34.9
- obese class II: 35.0 to 39.9
- obese class III: ≥ 40.0.[23]

Height and weight were self-reported by CCHS and NPHS respondents.

The presence of a *chronic condition* was established by asking respondents if a doctor had told them that they had a chronic disease that had lasted, or was expected to last, at least six months. Respondents were read a list of conditions; cancer, respiratory disease, high blood pressure, heart disease, arthritis and diabetes were selected for this analysis.

In middle-aged and older people, many of whom are retired and own their homes, level of income may not be a reliable indicator of socio-economic status. In an effort to identify people of limited means, respondents were asked about their *main source of income*. Response categories were: wages and salaries; income from self-employment; dividends and interest (for example, on bonds or savings); Employment Insurance; Workers' Compensation; Canada or Québec Pension Plan benefits; retirement pension, superannuation and annuities; Old Age Security and Guaranteed Income Supplement; Child Tax Benefit; provincial or municipal social assistance or welfare; child support; alimony; and other (rental income or scholarships, for example). Respondents who identified Canada or Québec Pension Plan benefits, Old Age Security and Guaranteed Income Supplement, or provincial/municipal social assistance or welfare were categorized as receiving *social assistance* as their main income source.

Two *smoking status* categories were defined: smokers and non-smokers. Smokers are those smoking either daily or occasionally and, in this case, "occasionally" includes only current occasional smokers who used to smoke every day. Non-smokers comprises people who had never smoked, plus occasional smokers who had never smoked every day, as well as former smokers (daily or occasional smokers who had quit smoking altogether).

Level of *leisure-time physical activity* was based on calculations that took into account the reported frequency and duration of a respondent's leisure-time physical activities in the three months before the survey, and the estimated metabolic energy demand of each activity.[24,25] Leisure was classified as active (3.0 or more kilocalories per kilogram per day), moderately active (1.5 to 2.9 kcal/kg/day), or inactive (below 1.5 kcal/kg/day).

Living arrangements were defined dichotomously as living alone or with others.

The presence of *pain* was established based on a "no" response to the question, "Are you usually free of pain or discomfort?"

an important exception. Although including obesity-related chronic diseases weakened the odds ratios slightly, BMI remained significantly related to dependency for women in all three categories of obesity (Appendix Table B, Model 4; Table 2). Thus any degree of obesity appears to make its own contribution to dependency for women, aside from the influences of obesity-related conditions.

Effects of pain compounded by obesity

Previous research has indicated that the likelihood of pain increases with BMI,[26] and that pain is strongly related to physical function.[5,27] For men, when pain was accounted for (see *Methods*) together with age, source of income and educational attainment, living arrangements, health-related behaviours and chronic conditions unrelated to obesity, the odds that those in obese classes II and III would be dependent were still significantly elevated (Table 3). In fact, the odds that men in obese class III would be dependent were over 6 times higher than the odds for men in the normal BMI range when pain was taken into account.

The odds ratio for pain was also high, and strongly significant. Notably, with pain in the model, the relationship between underweight and dependency was no longer statistically significant. When an interaction term for obesity (classes I to III combined) and pain was included in the model, its odds ratio was also significantly elevated (2.3; 95% confidence interval = 1.1 - 4.7), indicating that for men with chronic pain, obesity compounds the probability of dependency (data not shown).

The results for women were similar (Table 3). For, women, however, obesity at all three levels remained significantly related to dependency when pain was taken into account. The interaction term for obesity and pain was not significant for women (data not shown).

Table 3
Adjusted odds ratios relating BMI category and selected characteristics to dependency, controlling for pain, by sex, household population aged 45 or older, Canada, 2003

	Men		Women	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Age (continuous)	1.1*	1.1, 1.1	1.1*	1.1, 1.1
Socio-economic factors				
Less than secondary graduation	0.7*	0.5, 0.9	0.6*	0.5, 0.7
Secondary graduation or more†	1.0	...	1.0	...
Main source of income is social assistance‡	1.4*	1.0, 1.8	1.2	1.0, 1.4
Lives alone‡	1.2	0.9, 1.6	0.7*	0.6, 0.8
Body mass index (BMI)				
Underweight (< 18.5)	1.3	0.6, 3.2	1.5	1.0, 2.4
Normal (18.5-24.9)‡	1.0	...	1.0	...
Overweight (25.0-29.9)	1.3	1.0, 1.7	1.0	0.8, 1.3
Obese class I (30.0-34.9)	1.2	0.8, 1.7	1.4*	1.1, 1.7
Obese class II (35.9-39.9)	2.2*	1.1, 4.6	2.2*	1.5, 3.1
Obese class III (≥ 40)	6.2*	2.8,13.5	4.2*	2.5, 7.2
Smoking status				
Smoker	1.3	1.0, 1.7	1.2	1.0, 1.5
Non-smoker†	1.0	...	1.0	...
Leisure-time physical activity				
Inactive	3.9*	2.6, 5.9	3.5*	2.6, 4.7
Moderate	1.9*	1.2, 3.0	1.5*	1.0, 2.1
Active†	1.0	...	1.0	...
Chronic conditions				
Respiratory disease‡	3.1*	2.2, 4.4	2.0*	1.5, 2.6
Cancer‡	2.4*	1.4, 4.1	2.0*	1.3, 3.0
Pain‡	4.1*	3.1, 5.4	3.4*	2.9, 4.1

Data source: *2003 Canadian Community Health Survey*
Notes: *Based on records for 14,882 men and 19,502 women. Variables for "missing" BMI, leisure-time activity level and main source of income were included in the models to maximize sample size, but the odds ratios are not shown. Because of rounding, some odds ratios with 1.0 as the lower confidence interval are statistically significant.*
† Reference category
† Reference category
‡ Reference category is absence of condition; for example, reference category for pain is no reported chronic pain.
** Significantly different from estimate for reference category (p < 0.05)*
··· Not applicable

Obesity predictive of dependency

Findings from respondents followed over time differed somewhat from those based on the 2003 data (partly because of a smaller sample size resulting in less statistical power). According to longitudinal data from the NPHS, before controlling for obesity-related chronic conditions, only men in obese class I at the outset of a two-year period had significantly elevated odds of dependency by the end (Table 4). Because of the small sample size in the category, the odds ratio for men in obese class III fell just short of significance (p = 0.051). When controlling for well-known obesity-related conditions (heart disease, high blood pressure, diabetes, arthritis) and pain, underweight was the only BMI category to remain predictive of dependency among men.

The relationship between obesity and subsequent dependency was more pronounced for women (Table 5). Before the obesity-related conditions were taken into account, underweight women, as well as those in obese classes II and III, had significantly higher odds of becoming dependent over the next two years, compared with women in the normal BMI range. But when the obesity-related chronic

Limitations

The analyses are based on self-reported data. Because overweight and obese people tend to underreport their weight,[28] the results may have been somewhat distorted by non-random misclassification. Such bias would weaken the observed strength of the association between body mass index (BMI) category and dependency.

BMI is based on height and weight, and does not take factors such as percentage of body fat or waist circumference into account. As well, the same BMI cutpoints are applied to both sexes, even though body fat mass is higher in women than men for the same BMI category.[29] Previous studies in which BMI categories were defined according to the distribution in a specific population cannot be generalized to represent other populations.[2,3,6] This point is especially relevant in view of the rapid increase of obesity among Canadian adults.[30]

No information is available on weight loss due to illness. Also, although it is reasonable to assume that underweight is an indicator of frailty and compromised health, this analysis may not have adequately controlled for these factors.

The potential for selection bias due to respondent attrition is problematic in longitudinal research. Selective loss to follow-up, or failure to collect information from respondents who were in poorer health or whose health deteriorated rapidly between survey cycles, may have weakened the observed relationship between obesity and the onset of physical dysfunction. The analysis was based on respondents aged 45 or older for whom requisite data were available over the first five NPHS cycles. From one survey cycle to the next, respondents were lost from the analysis for reasons such as refusal to participate, death, item non-response, or relocation out of the country. From the pooled total of 21,390 respondents assessed in the "baseline" cycles, 1,417 (6.6%) did not respond in the follow-up cycle.

Respondents and non-respondents (unweighted sample), household population aged 45 or older, by two-cycle interval, National Population Health Survey, 1994/95 to 2002/03

	Number of respondents at baseline	Number of respondents at follow-up	Number (percentage) of respondents at baseline who became non-respondents next cycle
1994/95 to 1996/97 (Cycle 1 to 2)	5,547	5,247	300 (5.4%)
1996/97 to 1998/99 (Cycle 2 to 3)	5,388	5,097	291 (5.4%)
1998/99 to 2000/01 (Cycle 3 to 4)	5,241	4,875	366 (7.0%)
2000/01 to 2002/03 (Cycle 4 to 5)	5,214	4,754	460 (8.8%)
Total	**21,390**	**19,973**	**1,417 (6.6%)**

Loss to follow-up from the longitudinal panel was minimized in two ways. Instead of being excluded from the analysis, people who entered long-term care facilities were categorized as having become ADL-/IADL-dependent. Also, data from respondents were considered in two-year intervals. Therefore, those who were interviewed in at least two successive survey cycles were included in the analysis, even though they may have been subsequently lost to follow-up. This approach also allowed those who became eligible for analysis (for example, reached age 45) sometime after the first interview cycle to be included.

To assess the effects of non-response on the results, the weighted proportions of non-respondents were compared for a few selected variables (age group, sex, BMI). No significant differences in the proportions of non-respondents emerged by sex or the six BMI categories. By age group, the proportion of non-respondents was slightly higher among those aged 45 to 64 (7.8%) than among seniors (6.3%).

Non-respondents (weighted data), by selected variables, household component, National Population Health Survey, 1994/95 to 2002/03

	Non-respondents %
Age group	
45 to 64	7.8*
65 or older	6.3
Sex	
Men	7.4
Women	7.2
Body mass index (BMI)	
Underweight (< 18.5)	7.2
Normal (18.5 to 24.9)	7.7
Overweight (25.0 to 29.9)	6.9
Obese class I (30.0 to 34.9)	6.3
Obese class II (35.0 to 39.9)	5.6
Obese class III (≥ 40)	5.8

** Significantly higher than proportion of non-respondents for 65-or-older age group ($p < 0.05$)*

The survey weights were those applied to the cycle 1 (1994/95) data according to the response status at that time; the weights were not inflated to account for subsequent non-response. This could have biased the estimates if continuers in the longitudinal panel differed from non-respondents according to characteristics considered in the analysis.

No inference of causality or temporal ordering is possible from analyses based on the CCHS, because the data are cross-sectional. Although the NPHS longitudinal data were used to establish the chronological sequence between independent and dependent variables, causality (of dependency by obesity) cannot be inferred. The associations observed may result from factors not considered in this analysis.

The dependent variable, that is, the need for help from another person with selected instrumental and personal activities of daily living, was based on self-report and was not validated against objective criteria or by direct observation. Variation in unmeasured subjective factors, such as readiness to admit a need for assistance, likely explains some of the observed differences in responses.

Assessment of chronic diseases was made by asking respondents about conditions that had been diagnosed by a health practitioner and that had lasted, or were expected to last, six months or more. No clinical validation of these self-reported conditions was carried out.

Table 4
Adjusted odds ratios relating BMI category and selected characteristics to subsequent dependency, male household population aged 45 or older, Canada, 2003

	Model 1		Model 2	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Age (continuous)	1.1*	1.1, 1.1	1.1*	1.1, 1.1
Socio-economic factors				
Less than secondary graduation	1.1	0.9, 1.4	1.1	0.9, 1.5
Secondary graduation or more†	1.0	...	1.0	...
Main source of income is social assistance‡	1.5*	1.2, 1.9	1.4*	1.1, 1.7
Lives alone‡	1.1	0.8, 1.4	1.1	0.9, 1.5
Body mass index (BMI)				
Underweight (< 18.5)	2.5	1.0, 6.5	2.5*	1.0, 6.1
Normal (18.5-24.9)‡	1.0	...	1.0	...
Overweight (25.0-29.9)	1.0	0.7, 1.3	0.9	0.7, 1.2
Obese class I (30.0-34.9)	1.5*	1.0, 2.1	1.2	0.8, 1.7
Obese class II (35.9-39.9)	0.8	0.3, 2.3	0.6	0.2, 1.7
Obese class III (≥ 40)	2.9	1.0, 8.2	1.9	0.6, 5.8
Smoking status				
Smoker	1.4*	1.0, 2.0	1.4*	1.0, 2.0
Non-smoker†	1.0	...	1.0	...
Leisure-time physical activity level				
Inactive	1.3	1.0, 1.6	1.3*	1.0, 1.6
Moderate/Active†	1.0	...	1.0	...
Chronic conditions				
Respiratory disease‡	3.2*	2.1, 4.9	2.6*	1.7, 4.1
Cancer‡	0.9	0.5, 1.6	0.7	0.3, 1.4
Obesity-related chronic conditions				
High blood pressure‡			1.4*	1.0, 1.8
Heart disease‡			1.7*	1.2, 2.4
Diabetes‡			1.9*	1.4, 2.7
Arthritis‡			1.1	0.8, 1.4
Pain‡			2.5*	1.8, 3.3

Data source: *1994/95 to 2002/03 National Population Health Survey*
Notes: *Models 1 and 2 are based on 8,993 and 8,966 records, respectively. Because of rounding, some odds ratios with 1.0 as the lower confidence interval are statistically significant.*
† Reference category
‡ Reference category is absence of condition; for example, reference category for cancer is no reported diagnosis of cancer.
** Significantly different from estimate for reference category (p < 0.05)*
··· Not applicable

Table 5
Adjusted odds ratios relating BMI category and selected characteristics to subsequent dependency, female household population aged 45 or older, Canada, 2003

	Model 1		Model 2	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Age (continuous)	1.1*	1.1, 1.1	1.1*	1.1, 1.1
Socio-economic factors				
Less than secondary graduation	1.1	0.9, 1.4	1.1	0.9, 1.3
Secondary graduation or more†	1.0	...	1.0	...
Main source of income is social assistance‡	1.2	1.0, 1.5	1.0	0.8, 1.3
Lives alone‡	0.9	0.8, 1.1	0.9	0.8, 1.1
Body mass index (BMI)				
Underweight (< 18.5)	1.9*	1.3, 2.9	2.2*	1.4, 3.3
Normal (18.5-24.9)‡	1.0	...	1.0	...
Overweight (25.0-29.9)	1.2	1.0, 1.5	1.0	0.8, 1.3
Obese class I (30.0-34.9)	1.2	0.9, 1.6	1.0	0.7, 1.3
Obese class II (35.9-39.9)	2.0*	1.3, 3.0	1.5	1.0, 2.2
Obese class III (≥ 40)	3.0*	1.4, 6.5	2.6*	1.2, 5.5
Smoking status				
Smoker	1.6*	1.2, 2.0	1.6*	1.3, 2.0
Non-smoker†	1.0	...	1.0	...
Leisure-time physical activity level				
Inactive	1.6*	1.3, 1.9	1.4*	1.2, 1.7
Moderate/Active†	1.0	...	1.0	...
Chronic conditions				
Respiratory disease‡	1.7*	1.1, 2.5	1.3	0.9, 1.9
Cancer‡	1.4	0.8, 2.2	1.3	0.8, 2.1
Obesity-related chronic conditions				
High blood pressure‡			1.0	0.8, 1.2
Heart disease‡			1.7*	1.3, 2.3
Diabetes‡			2.3*	1.6, 3.2
Arthritis‡			1.4*	1.2, 1.7
Pain‡			2.5*	2.0, 3.1

Data source: *1994/95 to 2002/03 National Population Health Survey*
Notes: *Models 1 and 2 are based on 10,882 and 10,857 records, respectively.*
† Reference category
‡ Reference category is absence of condition; for example, reference category for cancer is no reported diagnosis of cancer.
** Significantly different from estimate for reference category (p < 0.05)*
··· Not applicable

conditions and pain were introduced in the model, the odds ratios remained significantly elevated only for underweight and obese class III women.

The longitudinal relationship between BMI and dependency and a stronger effect of BMI in predicting disability in women than men are consistent with other research.[3,5,7-10,31] Among men, obesity-related diseases appear to be associated more directly with dependency than is obesity. By contrast, the relationship between obesity and dependency persisted for women even when the effects of obesity-related diseases and pain were taken into account.

Concluding remarks

The findings of this study indicate that obesity is associated with co-existing dependency in middle-aged and older Canadians. This relationship persisted even when controlling for potentially confounding factors such as socio-economic status, living arrangements and level of physical activity, as well as chronic disease and pain. The results suggest that, in addition to its associations with pain and disease, obesity independently contributes to dependency.

Also important is the association between underweight and dependency. Both men and women who were categorized as underweight had strikingly higher odds of dependency when compared with their counterparts in the normal BMI range.

Longitudinal data from the National Population Health Survey were used to establish the order of events between obesity and dependency. Obesity was found to be predictive of future dependency in men and women aged 45 or older.

In Canada today, one of the most troubling public health dilemmas is the rising prevalence of overweight and obesity, now affecting the majority of middle-aged and older adults.[30] Despite cultural norms that stigmatize excess weight, along with ample evidence of its adverse health effects, the proportion of Canadian adults who are obese has risen considerably over the past few decades.[30]

Loss of independence is a dire consequence of obesity. Caring for people who need assistance with basic activities of daily living usually falls first to family members or friends. When these sources of help are unavailable, formal home care services may be sought. Dependency is also strongly predictive of eventual institutionalization.[7] In view of recent rapid increases in the proportion of people who are obese, coupled with the aging of the population, the burden on informal caretakers and the health care system can be expected to increase in the near future. ●

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Appendix

Table A

Adjusted odds ratios relating BMI level and selected characteristics to dependency, male household population aged 45 or older, Canada, 2003

	Model 1		Model 2		Model 3		Model 4	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Age (continuous)	1.1*	1.0, 1.1	1.1*	1.0, 1.1	1.0*	1.0, 1.1	1.0*	1.0, 1.0
Socio-economic factors								
Less than secondary graduation	1.5*	1.3, 1.7	1.2*	1.0, 1.4	1.2*	1.0,1 .4	1.2	1.0, 1.3
Secondary graduation or more†	1.0	...	1.0	...	1.0	...	1.0	...
Main source of income is social assistance‡	2.1*	1.8, 2.4	2.2*	1.9, 2.6	2.1*	1.8, 2.5	1.9*	1.6, 2.3
Lives alone‡	1.2*	1.1, 1.4	1.4*	1.2, 1.6	1.4*	1.3, 1.7	1.5*	1.3, 1.7
Body mass index (BMI)								
Underweight (< 18.5)			2.2*	1.4, 3.4	2.0*	1.2, 3.1	2.0*	1.3, 3.2
Normal (18.5-24.9)†			1.0	...	1.0	...	1.0	...
Overweight (25.0-29.9)			1.0	0.8, 1.2	1.0	0.9, 1.2	0.9	0.7, 1.0
Obese class I (30.0-34.9)			1.4*	1.1, 1.8	1.4*	1.1, 1.8	1.1	0.9, 1.4
Obese class II (35.9-39.9)			1.6*	1.1, 2.2	1.5*	1.1, 2.1	1.0	0.7, 1.4
Obese class III (≥ 40)			6.3*	3.0,13.0	6.3*	3.0,13.1	3.6*	2.0, 6.6
Smoking status								
Smoker			1.4*	1.2, 1.7	1.4*	1.1, 1.6	1.4*	1.1, 1.6
Non-smoker†			1.0	...	1.0	...	1.0	...
Leisure-time physical activity								
Inactive			2.8*	2.2, 3.5	2.7*	2.2, 3.4	2.6*	2.1, 3.3
Moderate			1.2	0.9, 1.6	1.2	0.9, 1.6	1.2	0.9, 1.6
Active†			1.0	...	1.0	...	1.0	...
Chronic conditions								
Respiratory disease‡					2.5*	2.1, 3.0	2.2*	1.8, 2.6
Cancer‡					2.4*	1.9, 3.0	2.1*	1.7, 2.7
Obesity-related chronic conditions								
High blood pressure‡							1.2*	1.0, 1.4
Heart disease‡							1.9*	1.6, 2.2
Diabetes‡							1.6*	1.3, 2.0
Arthritis‡							2.3*	2.0, 2.7

***Data source**: 2003 Canadian Community Health Survey*

***Notes:** Based on weighted data from records of 29,313 (Model 1), 29,112 (Model 2), 29,059 (Model 3), and 28,880 (Model 4) male respondents who provided information on mobility function. Variables for "missing" BMI and main source of income were included in the models to maximize sample size, but the odds ratios are not shown. Because of rounding, some odds ratios with 1.0 as the lower confidence interval are statistically significant.*

† Reference category

† Reference category

‡ Reference category is absence of condition; for example, reference category for cancer is no reported diagnosis of cancer.

** Significantly different from estimate for reference category ($p < 0.05$)*

··· Not applicable

Table B
Adjusted odds ratios relating BMI level and selected characteristics to dependency, female household population aged 45 or older, Canada, 2003

	Model 1		Model 2		Model 3		Model 4	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Age (continuous)	1.1*	1.1, 1.1	1.1*	1.1, 1.1	1.1*	1.1, 1.1	1.0*	1.0, 1.1
Socio-economic factors								
Less than secodnary graduation	1.3*	1.2, 1.4	1.1	1.0, 1.2	1.1	0.9, 1.2	1.0	0.9, 1.1
Secondary graduation or more†	1.0	...	1.0	...	1.0	...	1.0	...
Main source of income is social assistance‡	1.3*	1.2, 1.5	1.4*	1.3, 1.6	1.4*	1.2, 1.6	1.3*	1.1, 1.4
Lives alone‡	0.9*	0.8, 0.9	1.0	0.9, 1.1	0.9	0.9, 1.0	0.9	0.9, 1.0
Body mass index (BMI)								
Underweight (< 18.5)			2.0*	1.5, 2.6	1.8*	1.3, 2.4	1.9*	1.4, 2.6
Normal (18.5-24.9)†			1.0	...	1.0	...	1.0	...
Overweight (25.0-29.9)			1.1	1.0, 1.2	1.1	1.0, 1.2	1.0	0.9, 1.1
Obese class I (30.0-34.9)			1.6*	1.4, 1.8	1.5*	1.3, 1.8	1.2*	1.0, 1.4
Obese class II (35.9-39.9)			2.2*	1.8, 2.7	2.1*	1.7, 2.5	1.6*	1.2, 2.0
Obese class III (≥ 40)			3.6*	2.6, 4.9	3.4*	2.4, 4.6	2.3*	1.6, 3.2
Smoking status								
Smoker			1.4*	1.2, 1.6	1.3*	1.2, 1.5	1.3*	1.2, 1.6
Non-smoker†			1.0	...	1.0	...	1.0	...
Leisure-time physical activity								
Inactive			2.6*	2.2, 3.1	2.6*	2.2, 3.0	2.4*	2.1, 2.9
Moderate			1.2	1.0, 1.4	1.1	0.9, 1.4	1.1	0.9, 1.3
Active†			1.0	...	1.0	...	1.0	...
Chronic conditions								
Respiratory disease‡					2.6*	2.2, 3.0	2.1*	1.8, 2.5
Cancer‡					2.3*	1.8, 2.9	2.2*	1.7, 2.9
Obesity-related chronic conditions								
High blood pressure‡							1.1	1.0, 1.2
Heart disease‡							2.1*	1.8, 2.4
Diabetes‡							1.7*	1.4, 2.0
Arthritis‡							2.4*	2.1, 2.6

***Data source**: 2003 Canadian Community Health Survey*
***Notes:** Based on records of 38,242 (Model 1), 38,035 (Model 2), 37,968 (Model 3), and 37,783 (Model 4) female respondents who provided information on mobility function. Variables for "missing" BMI and main source of income were included in the models to maximize sample size, but the odds ratios are not shown. Because of rounding, some odds ratios with 1.0 as the lower confidence interval are statistically significant.*
† Reference category
† Reference category
‡ Reference category is absence of condition; for example, reference category for cancer is no reported diagnosis of cancer.
** Significantly different from estimate for reference category ($p < 0.05$)*
··· Not applicable


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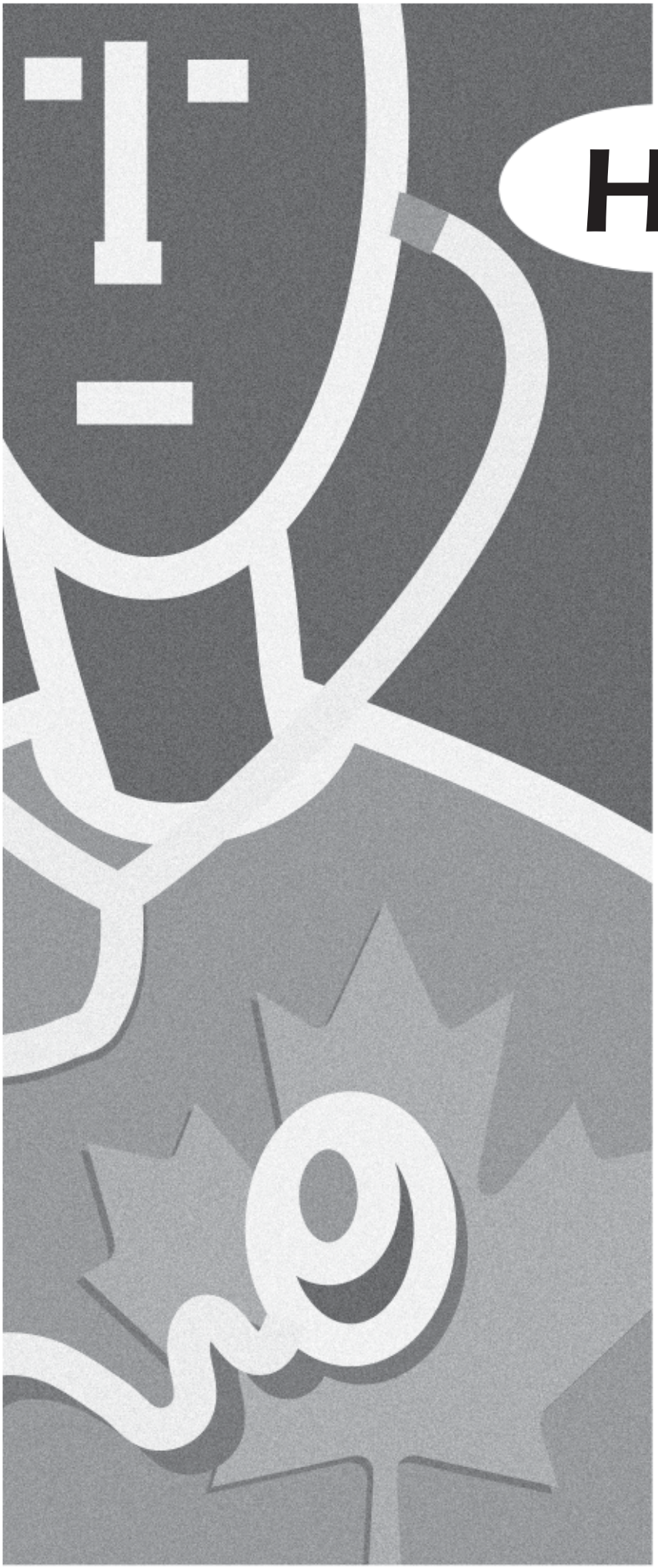

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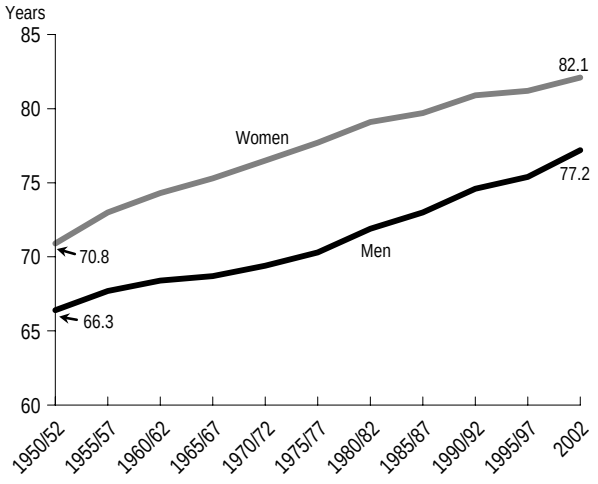
LIFE EXPECTANCY

by Julie St-Arnaud, Marie P. Beaudet and Patricia Tully

Life expectancy is an estimate of the number of years a person would be expected to live, based on age- and sex-specific mortality rates for a given period, under the assumption that these mortality rates would stay constant over subsequent years. Life expectancy, which can be used to compare groups across years, geographical areas or characteristics, is a common indicator of population health.

Life expectancy differs from "average length of life," which is based on multiple years of mortality data for persons born in the same year.[1] As well, life expectancy must be distinguished from "disability-free life expectancy," which refers to years lived outside a health institution or without major activity limitations.[2] While increased life expectancy does not necessarily result in improved quality of life or better health, a long life generally implies better health.

Life expectancy at birth, by sex, Canada, 1950-1952 to 2002



Data sources: *Vital Statistics Birth and Death Databases; estimates of population by age and sex for Canada, the provinces and the territories, Statistics Canada*
Notes: *Calculations for 1950-1952 to 1995-1997 are based on complete life tables; calculations for 2002 are based on an abridged life table.*

Male-female gap narrowing

In 2002, average life expectancy at birth in Canada was 79.7 years: 77.2 years for men and 82.1 years for women. Half a century earlier in 1951, men's life expectancy had been 66.3 years, and women's, 70.8 years, or about 11 years less for each sex.

Although women maintained an advantage over men throughout the period, two opposing trends can be observed in the male-female differences in life expectancy. From 1951 to 1976, the gap widened from 4.5 to 7.3 years, owing to faster gains for women. The next quarter century saw the gap narrow, as life expectancy increased more rapidly for men than for women. In 2002, the difference was 4.9 years, only slightly wider than it had been 50 years earlier.

Mortality rates drop for leading causes of death

Since the end of the 1970s, the leading causes of death in Canada have been diseases of the circulatory system (mainly cardiovascular disease and stroke) and cancer. Mortality rates for diseases of the circulatory system remained higher among men than women, although reductions in mortality rates for specific circulatory system diseases were substantial for both sexes. As well, the pace of the decline varied. For example, the drop in mortality rates for acute myocardial infarction (heart attack) was slightly more pronounced among men: down 67.4% compared with a 63.7% decrease among women. For both sexes, stroke mortality rates fell by about 50%.

From 1979 through 2002, cancer mortality rates were higher among men than among women. During this period, women's mortality rate from cancers of the colon, rectum and anus fell much more sharply than did men's, and the decline in female breast cancer mortality was greater than the

drop in prostate cancer mortality. However, while men's mortality rate for cancers of the trachea, bronchus and lung decreased, the rate for women more than doubled.

The improvement in men's life expectancy since the end of the 1970s reflects, among other things, the declining mortality rates for these major causes of death. Women's smaller gain indicates a more complex process: the reduction in mortality rates for acute myocardial infarction, stroke and some cancers, along with the striking rise in lung cancer mortality.

Age-standardized mortality rates, by sex, selected causes of death, Canada, 1979 and 2002

Age-standardized deaths per 100,000 standard population

	Men			Women		
	1979	2002	% change	1979	2002	% change
Acute myocardial infarction	214.6	70.0	-67.4	94.1	34.2	-63.7
Cerebrovascular disease	87.8	43.7	-50.2	73.4	36.3	-50.5
Cancers of trachea, bronchus and lung	71.7	65.6	-8.5	16.3	35.3	+116.6
Cancers of colon, rectum and anus	28.6	24.1	-15.7	23.3	15.2	-34.8
Prostate cancer	26.7	25.2	-5.6	...	...	...
Female breast cancer	...	...	...	29.8	24.4	-18.1

Data sources: Vital Statistics Death Databases, 1979 and 2002; estimates of population by age and sex for Canada, the provinces and the territories, Statistics Canada
··· Not applicable

Canadian men's life expectancy ranked fifth, at 77.1 years. Iceland had the longest male life expectancy (78.3 years), closely followed by Japan (78.1 years). As was the case for their female counterparts, American men did not place among the top 10 (74.4 years).

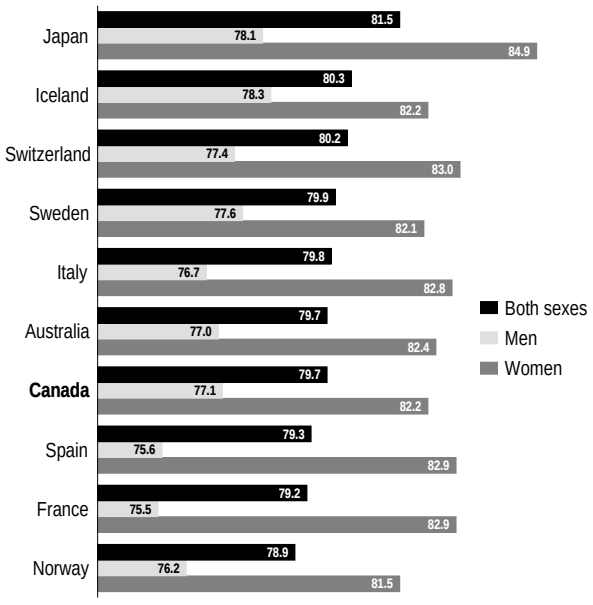
In some countries where life expectancy exceeds that in Canada, the gap between men and women was relatively wide. In fact, among the OECD countries with the longest life expectancies in 2001, Canada had the third-smallest male-female difference: 5.1 years. By contrast, the gap in Japan was 6.8 years.

Canada sixth among OECD countries

Since the 1960s, Canada has been among the 10 countries in the Organisation for Economic Co-operation and Development (OECD) with the longest life expectancies.[3] In 2001, Canada ranked sixth, with life expectancy estimated at 79.7 years for both sexes, on par with Australia.

For women, Canada and Iceland tied in sixth place, with life expectancy at 82.2 years. Japan was first with 84.9 years. In the United States, female life expectancy in 2001 was 79.8 years, too low to place among the top 10.

Life expectancy at birth, by sex, selected OECD countries, 2001



Data source: Organisation for Economic Co-operation and Development

Provinces and territories

The provinces with the longest life expectancies in 2002 were British Columbia, Ontario and Alberta: 80.6, 80.1 and 79.7 years, respectively. At 78.3 years, Newfoundland and Labrador had the shortest life expectancy. In the remaining provinces, the figure was around 79 years.

When the sexes were examined separately, British Columbia maintained its first-place ranking, with life expectancy of 78.2 years for men and 82.9 years for women—in both cases, about a year more than the national figures. Ontario

Life expectancy at birth, by sex and province/territory, Canada, 2002

	Both sexes	Men	Women	Male/Female difference
Canada	**79.7**	**77.2**	**82.1**	**4.9**
Newfoundland and Labrador	**78.3**	75.7	80.9	5.2
Prince Edward Island	**78.8**	76.2	81.3	5.1
Nova Scotia	**79.0**	76.4	81.5	5.1
New Brunswick	**79.3**	76.5	82.0	5.5
Québec	**79.4**	76.6	82.0	5.4
Ontario	**80.1**	77.7	82.2	4.5
Manitoba	**78.7**	76.2	81.1	4.9
Saskatchewan	**79.1**	76.3	82.0	5.7
Alberta	**79.7**	77.4	81.9	4.5
British Columbia	**80.6**	78.2	82.9	4.7
Yukon	**76.7**	73.9	80.3	6.4
Northwest Territories	**75.8**	73.2	79.6	6.4
Nunavut	**68.5**	67.2	69.6	2.4

Data sources: *Vital Statistics Birth and Death Databases; estimates of population by age and sex for Canada, the provinces and the territories, Statistics Canada*

and Alberta followed British Columbia in male life expectancy, both surpassing the national level. In the other provinces, male life expectancy was less than 77.2 years. Provincial variations in women's life expectancy were less pronounced. With three exceptions (Newfoundland and Labrador, Prince Edward Island and Manitoba), female life expectancy was around 82 years.

Life expectancy in the territories was lower than in the provinces. Nunavut residents' life expectancy in 2002 was 68.5 years, 11.2 years less than the figure for Canadians overall and similar to the national level half a century ago. In Yukon, life expectancy in 2002 was 76.7 years, and in the Northwest Territories, 75.8 years. Estimates for the territories and Prince Edward Island must be interpreted with caution because they are based on small populations and small numbers of deaths.

In each province and territory, women's life expectancy exceeded men's. The difference between the sexes was close to the national level (4.9 years) in most provinces and territories, except Nunavut, where the gap was 2.4 years.

Increase for all age groups

The longer a person lives, the more he/she belongs to a select group. The oldest members of the population have survived the longest period of exposure to the risk of death. For example, in 2002, a 1-year-old girl could expect to live to age 82.5, while a 50-year-old woman could expect to live to age 83.8.

Life expectancy for all age groups that were compared in this analysis rose significantly between 1996 and 2002. In 1996, boys aged 15 to 19 could expect to live an additional 61.2 years; in 2002,

Life expectancy, by age group and sex, Canada, 1996 and 2002

	1996	2002	Difference
Men			
0	75.5	77.2	1.8*
1-4	74.9	76.7	1.8*
5-9	71.0	72.8	1.7*
10-14	66.1	67.8	1.7*
15-19	61.2	62.9	1.7*
20-24	56.4	58.1	1.7*
25-29	51.6	53.3	1.6*
30-34	46.9	48.5	1.6*
35-39	42.2	43.7	1.5*
40-44	37.5	38.9	1.5*
45-49	32.9	34.3	1.4*
50-54	28.3	29.7	1.4*
55-59	24.0	25.3	1.3*
60-64	19.9	21.1	1.2*
65-69	16.1	17.2	1.1*
70-74	12.7	13.7	1.0*
75-79	9.8	10.5	0.8*
80-84	7.3	7.9	0.6*
85-89	5.4	5.6	0.3*
90+†	3.9	4.1	0.2
Women			
0	81.2	82.1	0.9*
1-4	80.6	81.5	0.9*
5-9	76.7	77.6	0.9*
10-14	71.8	72.6	0.8*
15-19	66.8	67.7	0.8*
20-24	61.9	62.8	0.8*
25-29	57.0	57.9	0.8*
30-34	52.1	53.0	0.8*
35-39	47.3	48.1	0.8*
40-44	42.4	43.3	0.8*
45-49	37.7	38.5	0.8*
50-54	33.0	33.8	0.8*
55-59	28.5	29.2	0.7*
60-64	24.1	24.8	0.7*
65-69	20.0	20.6	0.6*
70-74	16.1	16.7	0.6*
75-79	12.5	13.0	0.5*
80-84	9.4	9.8	0.4*
85-89	6.8	7.0	0.2*
90+†	4.8	5.0	0.1

Data sources: *Vital Statistics Birth and Death Databases; estimates of population by age and sex for Canada, the provinces and the territories, Statistics Canada*
Notes: *Estimates for 1996 based on an abridged life table for 1995 to 1997; estimates for 2002 based on an abridged life table for 2002. The difference between 1996 and 2002 was calculated from unrounded values.*
† Open group, not compared
** $p < 0.001$*

Data sources

Data on life expectancy and age-standardized mortality were calculated from the Vital Statistics Birth and Death Databases and estimates of population by age and sex for Canada, the provinces and the territories, Statistics Canada.

Life expectancy estimates for 1996 were calculated using mortality rates for 1995, 1996 and 1997; life expectancy estimates for 2002 were calculated using mortality rates for only that year. Estimates for 1996 and 2002 were calculated using Greville's[4] method for abridged life tables; life expectancy in such tables is calculated for five-year age groups.

Differences in life expectancy estimates by age group between 1996 and 2002 and the variance of these estimates were calculated using Chiang's method.[5]

Life expectancy estimates for 1950-1952 to 1995-1997 were calculated from complete life tables, using death data for three calendar years to calculate the mortality rates by single-year-of-age and sex.

International data are from the Organisation for Economic Cooperation and Development. International estimates are not strictly comparable, because life expectancy is not calculated by the same method in every country.[6] As well, the estimates provided by a country and those from the OECD may vary slightly, because the OECD adjusts each estimate to account for differences across countries in the calculation of life expectancy.

Age-standardized mortality rates were calculated to remove the effects of differences in the age structure of the 1979 and 2002 Canadian population. The 1991 Canadian Census of Population was used as the standard population; age-standardized mortality rates show the number of deaths per 100,000 population that would have occurred in a given period if the age structure of the population at that time was the same as the age structure of this standard population.[7]

Cause of death from 1979 to 1999 was classified according to the *International Classification of Diseases, Ninth Revision* (ICD-9)[8]; the *Tenth Revision* (ICD-10)[9] was used from 2000 on. Causes of death classified according to the two revisions are not strictly comparable. For this analysis, results of a study[10] that classified deaths to both ICD-9 and ICD-10 were used to adjust 1999 mortality data for the four cancers and the two circulatory system causes of death. When these adjustments were applied to the age-standardized mortality rates, the change had little or no effect on the direction or slope of the trend lines for these causes of death. The following codes were used to define the cause of death groups:

Cause of death group	ICD-9 Codes	ICD-10 Codes
Acute myocardial infarction	410	I21-I22
Cerebrovascular disease	430-438	I60-I69
Cancers of trachea, bronchus and lung	162	C33-C34
Cancers of colon, rectum and anus	153-154	C18-C21
Prostate cancer	185	C61
Female breast cancer	174	C50

the figure was 62.9 years. The corresponding estimates for girls were 66.8 and 67.7 years. During the same period, life expectancy at ages 55 to 59 rose from 24.0 to 25.3 years for men, and from 28.5 to 29.2 years for women.

In all age groups, women's life expectancy was longer than that of men. However, from 1996 to 2002, the increase in men's life expectancy surpassed women's in all age groups. For instance, in 2002, a 25-year-old woman could expect to live 0.8 years longer than had been the case in 1996, but for a 25-year-old man, the gain was 1.6 years. Similarly, for a woman aged 60, the increase in life expectancy was 0.7 years, compared with a gain of 1.2 years for a man aged 60.

As a result, the difference between male and female life expectancy for every age group diminished over this period. The male-female life expectancy gap at birth fell from 5.7 years in 1996 to 4.9 years in 2002. At age 65, the gap narrowed from 3.9 to 3.4 years.

Julie St-Arnaud (613-951-2068; Julie.St-Arnaud@statcan.ca), Marie P. Beaudet (613-951-7025; MarieP.Beaudet@statcan.ca) and Patricia Tully (613-951-1759; Patricia.Tully@statcan.ca) are with the Health Statistics Division at Statistics Canada, Ottawa, Ontario, K1A 0T6.

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10 Geran L, Tully P, Wood P, et al. *Comparability of ICD-10 and ICD-9 for Mortality Statistics in Canada* (Statistics Canada, Catalogue 84-548-XIE/XWE) 2005.


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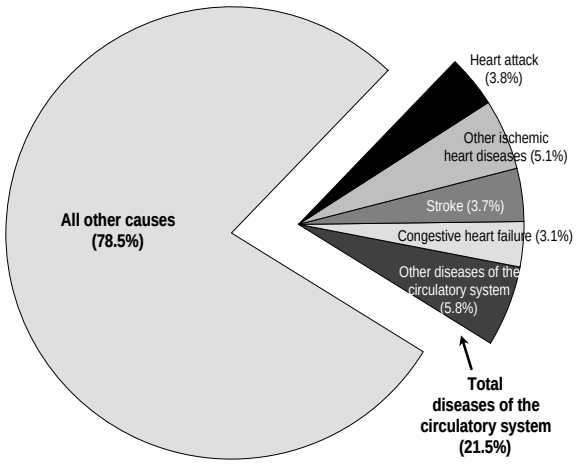
DISEASES OF THE CIRCULATORY SYSTEM — HOSPITALIZATION AND MORTALITY

by Helen Johansen, Satha Thillaiampalam, Denis Nguyen and Christie Sambell

Diseases of the circulatory system are the major cause of illness, disability, and death in Canada.[1] The most common of these diseases are ischemic heart disease (which includes acute myocardial infarction or heart attack), congestive heart failure, and cerebrovascular disease (stroke).

A heart attack is typically caused by a blockage (usually a blood clot) in a coronary artery that severely restricts or cuts off the blood supply to a region of the heart. If this lasts more than a few minutes, heart tissue dies.[2] Congestive heart failure occurs when the heart can no longer pump blood at the rate needed by the body's tissues. A stroke involves loss of brain function when a clot or piece of atherosclerotic plaque breaks away from another area of the body and blocks a blood vessel in the brain (ischemic), or when a blood vessel in the brain bursts (hemorrhagic), thereby allowing blood to leak into an area of the brain and destroy it.[3]

Percentage of patients aged 20 or older† hospitalized for diseases of the circulatory system, Canada, 2001/02



Data source: *Health Person-oriented Information Database*
† Excluding pregnancy and childbirth

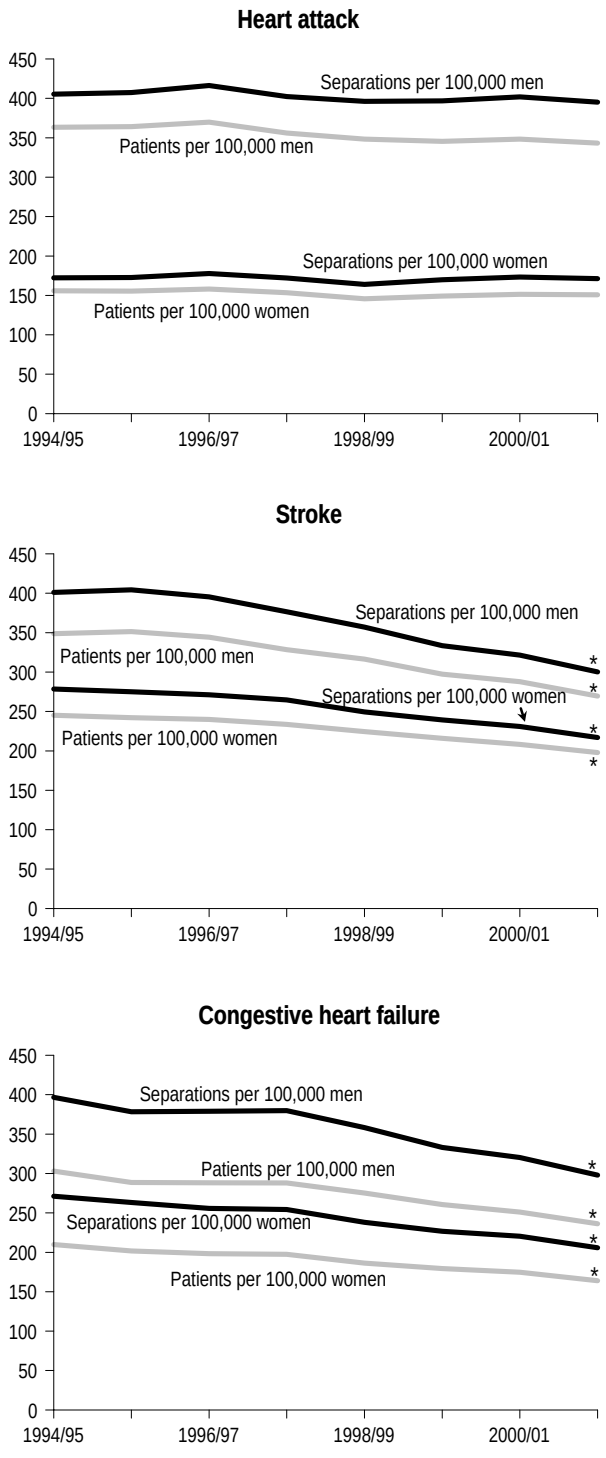
Leading cause of hospitalization

In 2001/02, more than 309,000 people were hospitalized because of diseases of the circulatory system. Some of these patients were admitted more than once for the same or related problems, so this group of diseases accounted for an even greater number of hospitalizations (separations) that year: 419,000.

By either measure—patients or separations—diseases of the circulatory system were the leading cause of hospitalization for adults, representing 26% of male patients aged 20 or older (24% of separations) and 18% of female patients (17% of separations, excluding pregnancy and childbirth).

Although diseases of the circulatory system accounted for large shares of patients and separations, age-standardized hospitalization rates for this disease group fell substantially between 1994/95 and 2001/02. Based on patients, the rate went from 1,656 to 1,339 per 100,000 population aged 20 or older. For separations, the rate fell from 2,268 to 1,813 per 100,000. The trend was similar for each of the major circulatory system diseases, and for both men and women, although the size of the declines varied.

Age-adjusted† hospitalization rates for heart attack, stroke and congestive heart failure, by sex, Canada, 1994/95 to 2001/02



Data source: *Health Person-oriented Information Database*
† Age-standardized to distribution of 2001 population aged 20 or older (five-year age groups)
** Significant decrease in trend from 1994/95 to 2001/02 (p < 0.05)*

Number of patients

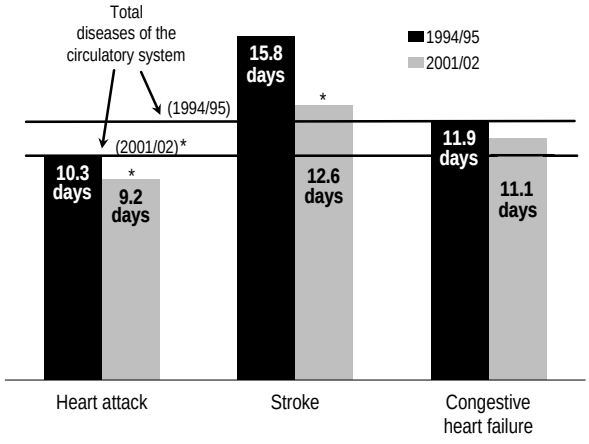
Overall, the total number of patients admitted to hospital for diseases of the circulatory system in 2001/02 (309,000) was down more than 4% from the 1994/95 figure (323,600). However, the decline in numbers did not apply to all diseases in this group. For instance, the number of heart attack patients actually rose from about 49,000 in 1994/95 to more than 55,000 in 2001/02. This likely reflects the increasing elderly population, the age group most likely to be hospitalized for such diseases.

Fewer hospital days

In 2001/02, diseases of the circulatory system accounted for 3.3 million days in acute care hospitals, down from almost 3.9 million days in 1994/95. Much of this decline resulted from a reduction in the average annual number of days in hospital for such patients: from 12.0 to 10.5.

These declines in total days and average annual days per patient mask trends for particular diseases. For example, the annual number of days per patient

Average annual number† of hospital days per patient for heart attack, stroke, congestive heart failure and total diseases of the circulatory system, Canada, 1994/95 and 2001/02



Data source: *Health Person-oriented Information Database*
† Age-/Sex-standardized to distribution of all circulatory system disease patients aged 20 or older in 1994/95 (five-year age groups)
** Significantly lower than 1994/95 (p < 0.05)*

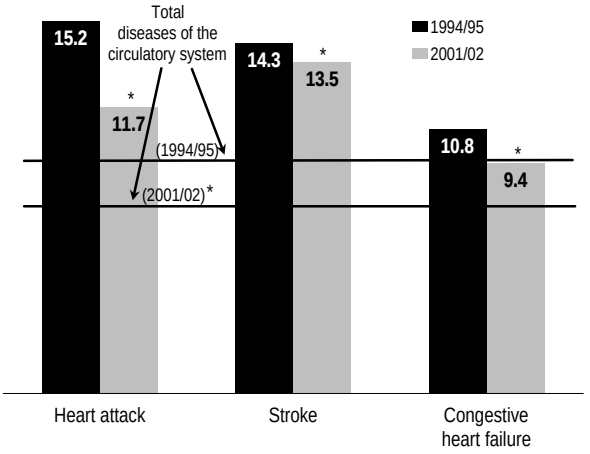
attributed to heart attack rose slightly over the period from 498,700 to 508,400, despite a reduction in average annual days per patient (from 10.3 to 9.2). By contrast, the total number of hospital days attributed to congestive heart failure decreased significantly, from 606,700 to 529,800, but the drop in average annual days per patient was not significant (11.9 to 11.1).

Mortality

The proportion of patients hospitalized for diseases of the circulatory system who die in hospital declined from 9.6% in 1994/95 to 8.4% in 2001/02. For heart attack patients, the drop was particularly sharp: from 15.2% to 11.7%.

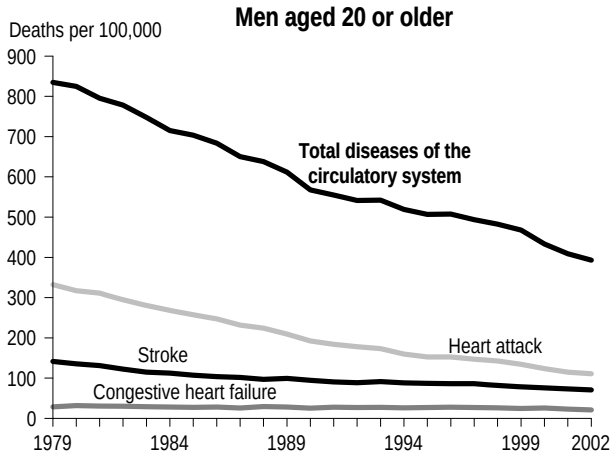
In fact, overall mortality (not just in-hospital deaths) from diseases of the circulatory system declined over two decades. For men aged 20 or older, the age-standardized rate fell from 835 deaths per 100,000 in 1979 to 393 in 2002; for women of the same ages, from 506 to 249. But while mortality

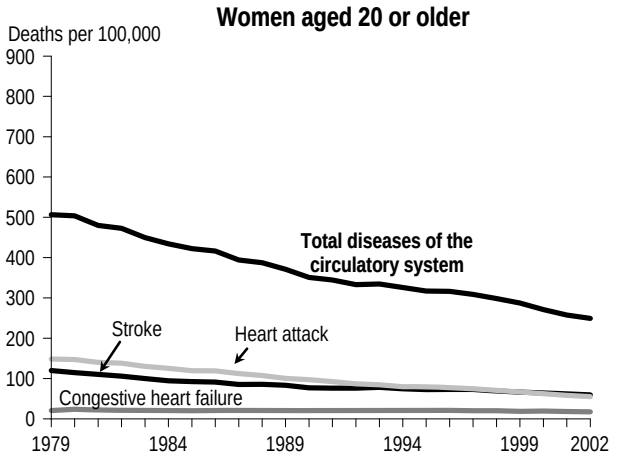
Percentage† of heart attack, stroke, congestive heart failure and total circulatory system disease patients who died in hospital, Canada, 1994/95 and 2001/02



Data source: *Health Person-oriented Information Database*
† Age-/Sex-standardized to distribution of all circulatory system disease patients aged 20 or older in 1994/95 (five-year age groups)
** Significantly lower than 1994/95 ($p < 0.05$)*

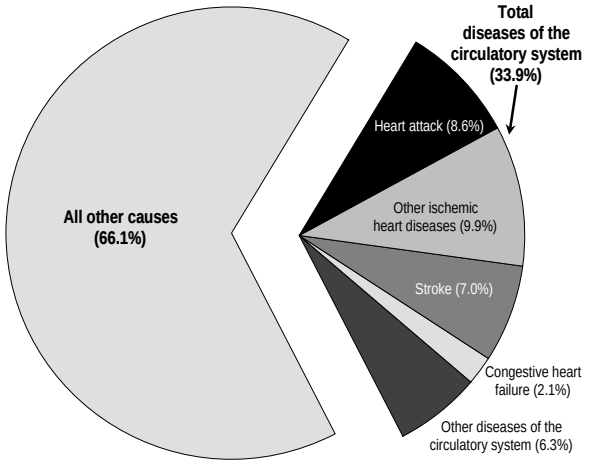
Age-standardized† mortality rates for selected diseases of the circulatory system, Canada, 1979 to 2002





Data source: *Canadian Mortality Database*
† Age-standardized to 2001 population aged 20 or older (five-year age groups)

Percentage of deaths† attributable to diseases of the circulatory system, Canada, 2002



Data source: *Canadian Mortality Database*
† Aged 20 or older

rates for heart attack and stroke dropped steadily, the rate for congestive heart disease was relatively stable.

In 2002, diseases of the circulatory system accounted for 74,530 deaths (34%) of people older than 20 and remained the leading cause of death of adults, at 311 deaths per 100,000 population (cancer ranked second at 273 deaths per 100,000).

Helen Johansen (613-722-5570; johahel@statcan.ca), Satha Thillaiampalam, Denis Nguyen and Christie Sambell are with Health Statistics Division at Statistics Canada, Ottawa, Ontario, K1A 0T6.

Data sources

Data on hospital separations and patients are from the Health Person-oriented Information (HPOI) Database, maintained by Statistics Canada. To determine the number of patients, acute care hospital records for each province for fiscal years 1994/95 to 2001/02 were linked using patient identification numbers. Only records for acute care hospitals and with stays less than 90 days were used.

Data on deaths attributed to diseases of the circulatory system are from the Canadian Mortality Database, which is maintained by Statistics Canada. The data are abstracted and compiled from death certificates by the vital statistics registrar in each province and territory.

Causes of hospitalization and death before 2000 were defined according to the *International Classification of Diseases, Ninth Revision* (ICD-9),[4] and those occurring in 2000 or later, according to the tenth revision of this volume (ICD-10).[5]

ICD-9 category titles	ICD-10 category titles	ICD-9 codes	ICD-10 codes
Diseases of the circulatory system	Diseases of circulatory system	390-459	I00-I99
Ischemic heart diseases	Ischemic heart diseases	410-414	I20-I25
Acute myocardial infarction (heart attack)	Acute myocardial infarction	410	I21
Stroke (cerebrovascular disease)	Cerebrovascular diseases	430-438	I60-I69
Congestive heart failure	Congestive heart failure	428	I50

Hospitalization and mortality rates were standardized to the age (five-year age groups) and sex distribution of the 2001 (July 1) population aged 20 or older. All hospital visits for each patient were combined into episodes to determine the total number of days each patient spent in hospital within the year. The average number of hospital days per patient within a year and the percentage of patients who die in hospital were age-/sex-standardized based on the distribution of all circulatory system disease patients in 1994/95. Changes in rates from 1994/95 to 2001/02 based on HPOI data were tested for significance using linear regression. The model utility test was used to determine if the slope differed significantly from 0.

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EDENTULISM AND DENTURE USE

by Wayne J. Millar and David Locker

In 2003, 9% of Canadians aged 15 or older reported that they had no natural teeth; that is, they were edentate. This estimate is based on data from the Canadian Community Health Survey (CCHS).

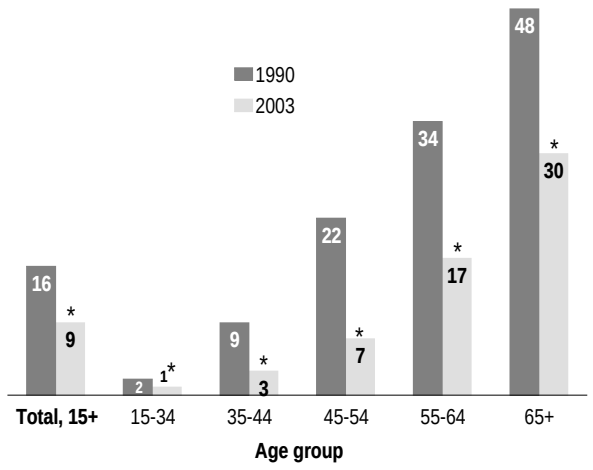
A comparison of estimates from the CCHS and the 1990 Health Promotion Survey reveals a decline in the prevalence of complete tooth loss. In 1990, 16% of the population was edentate. The largest decline in edentulism occurred in the older population. Close to half of individuals aged 65 or older (48%) were edentate in 1990; in 2003, the proportion was 30%.

This reduction is not surprising given the fairly widespread fluoridation of water and improved access to dental care.[1] Other contributing factors include growth of disposable income, improvements in dentist-to-population ratios and expansion of dental insurance coverage.[2-4]

Differences by sex and age

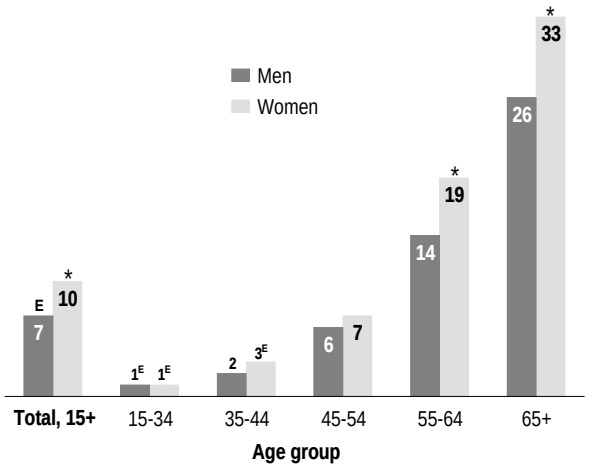
Overall, a higher proportion of women (10%) than men (7%) were edentate, and edentulism was most common at older ages. The male–female difference reflects the higher proportion of edentate women aged 55 or older.

Percentage of household population who were edentate, by age group, 1990 and 2003



Data sources: *1990 Health Promotion Survey; 2003 Canadian Community Health Survey*
** Significantly lower than estimate for 1990 ($p < 0.05$)*

Percentage of household population who were edentate, by age group and sex, 2003



Data source: *2003 Canadian Community Health Survey*
** Significantly higher than estimate for men ($p < 0.05$)*
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

By province

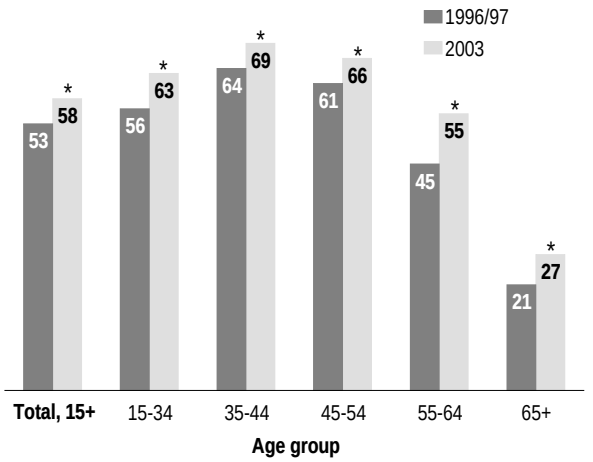
Québec had the highest rate of complete tooth loss (14%), and the Northwest Territories, the lowest (5%). Less widespread access to fluoridated water may have contributed to Québec's high rate of edentulism.[5] Smoking, which is known to be associated with periodontal disease,[6] may also be a factor. Smoking rates in Québec remain higher than the national average. Other studies have also found higher rates of tooth loss in Québec.[7]

Income, insurance

Employee benefit plans that help cover the costs of dental care have contributed to the decline in edentulism. And since 1996/97, the proportion of the population with dental insurance has increased in all age groups.

The percentage of Canadians in low income households who were

Percentage of household population with dental insurance, by age group, 1996/97 and 2003



Data sources: *1996/97 National Population Health Survey; 2003 Canadian Community Health Survey*
** Significantly higher than estimate for 1996/97 (p < 0.05)*

Denture use

According to the Canadian Community Health Survey, 24% of people aged 15 or older reported wearing dentures in 2003. Overall, denture use was more prevalent among women (26%) than men (23%)—especially for seniors.

Percentage of household population who wore dentures, by age group and sex, 2003

	Men	Women
	%	
Total, 15+	**23**	**26***
15-34	3[E]	3
35-44	12	12
45-54	31	27
55-64	45	50*
65+	58	66*

Data source: *2003 Canadian Community Health Survey*
** Significantly higher than estimate for men*
E Coefficient of variation 16.6% to 33.3% (interpret with caution)

Among people in low income households, 36% wore dentures. For those in high income households, the figure was 16%.

Denture use among people with no dental insurance coverage was about twice that for those who did have benefits: 35% versus 18%.

Not all people who are edentate wear dentures. In 2003, about 9% of the edentate population reported that they did not wear dentures.

Percentage of household population aged 15 or older who were edentate, by selected characteristics, 2003

	'000	%
Total	**25,307**	**9**
Sex		
Men	12,426	7
Women	12,881	10*
Age group		
15 to 34	8,353	1*
35 to 44	5,310	3*
45 to 54	4,623	6*
55 to 64	3,237	17*
65 or older	3,785	30*
Household income		
Low	1,945	18*
Lower-middle	4,199	14*
Upper-middle	7,450	8*
High	7,680	3*
Missing	4,033	11*
Dental insurance		
Yes	14,795	5*
No	9,585	15*
Missing	927	5*
Province/Territory		
Newfoundland and Labrador	441	13*
Prince Edward Island	113	7*
Nova Scotia	757	10
New Brunswick	610	12*
Québec	6,070	14*
Ontario	9,792	6*
Manitoba	873	7
Saskatchewan	755	12*
Alberta	2,468	7*
British Columbia	3,361	7*
Yukon	24	7
Northwest Territories	31	5*
Nunavut	13	7

Data source: *2003 Canadian Community Health Survey*
** Significantly different from estimate for total (p < 0.05)*

edentate was 18%, compared with 3% in the highest income households, indicating that complete tooth loss is closely associated with the ability to pay for dental services. Regardless of household income, however, people without benefit plans were more likely to be edentate in 2003.

Wayne J. Millar (613-951-1631; Wayne.Millar@statcan.ca) is with the Health Statistics Division at Statistics Canada in Ottawa, Ontario, K1A 0T6. David Locker is with the Department of Community Health Dentistry at the University of Toronto in Toronto, Ontario.

Data sources

Estimates are based on data from the 2003 (cycle 2.1) Canadian Community Health Survey (CCHS). The CCHS covers the household population aged 12 or older in all provinces and territories, except members of the regular armed forces and people living on Indian reserves, and in some remote areas. Data for cycle 2.1 were collected between January and December 2003. The overall response rate was 80.6%, and the sample size was 135,573. More detail about the sample design of the CCHS is available in a previously published report.[8]

Cycle 2.1 has two separate modules on oral health. All respondents answered the Oral Health 1 questions. The Oral Health 2 module was answered by a sub-sample of respondents. This study focuses on people aged 15 or older who answered the Oral Health 2 module. The sample size was 35,927, representing 25.3 million people. To account for the multi-stage sample design of the survey, the bootstrap technique was used for calculating confidence intervals and coefficients of variation and for testing the statistical significance of differences between prevalence estimates. A significance level of $p < 0.05$ was applied in all cases.[9-12]

The 1990 Health Promotion Survey (HPS) targeted all persons aged 15 or older residing in Canada, except full-time residents of institutions and residents of the Yukon and Northwest Territories. The survey used a random digit- dialled household design with a sample size of 13,792, representing 20.6 million people. The overall response rate was 78%. More information about the survey design is available in a published report.[13] Bootstrap weights were not available for the HPS. The design effect of the HPS was estimated to be 2.0 for all 10 provinces and closer to 1 for each province. To take this into account, adjusted standard errors were calculated by multiplying by the square root of the design effect.[14] These revised standard errors were used in the calculation of differences between rates in the HPS and CCHS.

Information about dental insurance was obtained from the 1996/97 National Population Health Survey (NPHS). The NPHS, which surveyed people aged 12 or older in Canada's household population, had an overall sample of 81,803 and a response rate of 79.0%. The sample size for people aged 15 or older, used in this analysis, was 70,884. More information about the survey can be found in a previous article.[15]

Questions

Canadian Community Health Survey (CCHS) respondents who said that they had no natural teeth were defined as *edentate*.

Respondents were asked if they wore "dentures or false teeth." *Denture use* does not discriminate between a partial denture, a complete upper plate or both upper and lower plates.

CCHS respondents were asked if they had insurance that covered all or part of their dental expenses and those who said "yes" were classified as having *dental insurance*.

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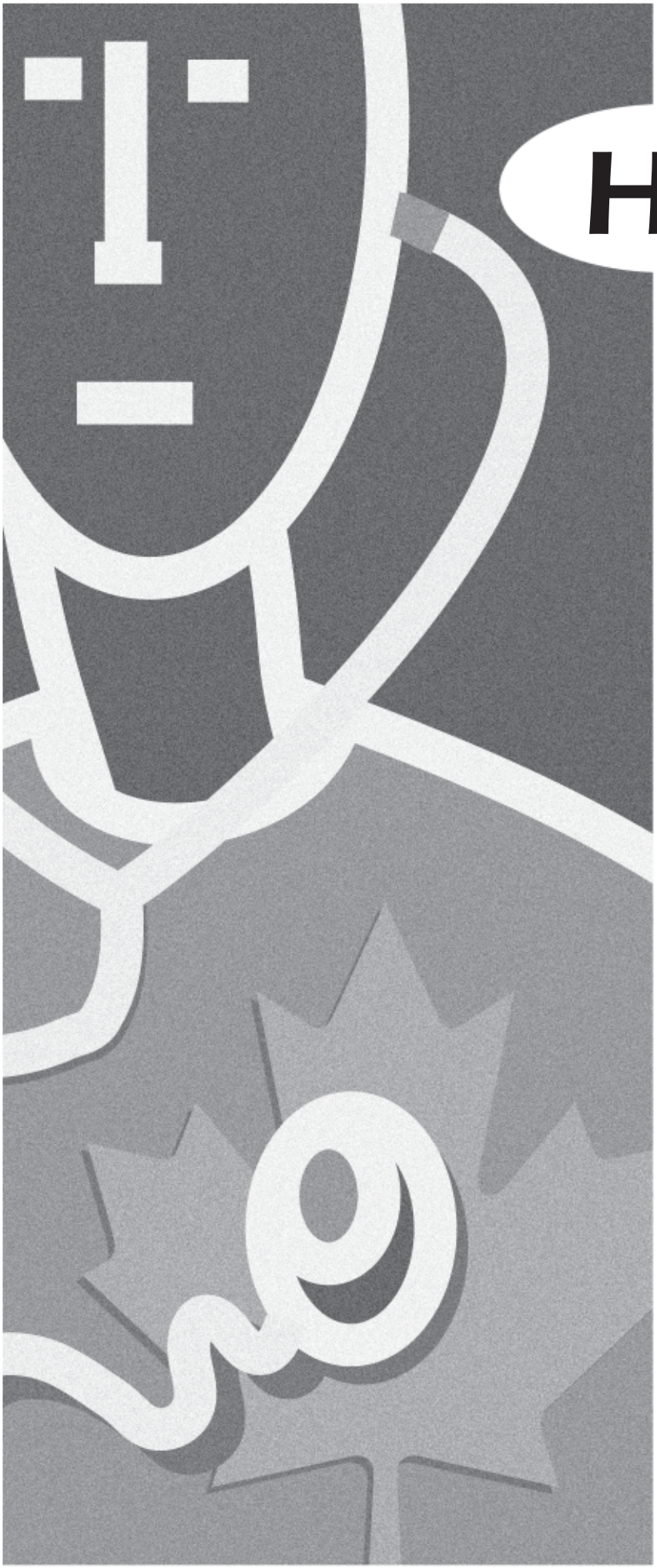

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