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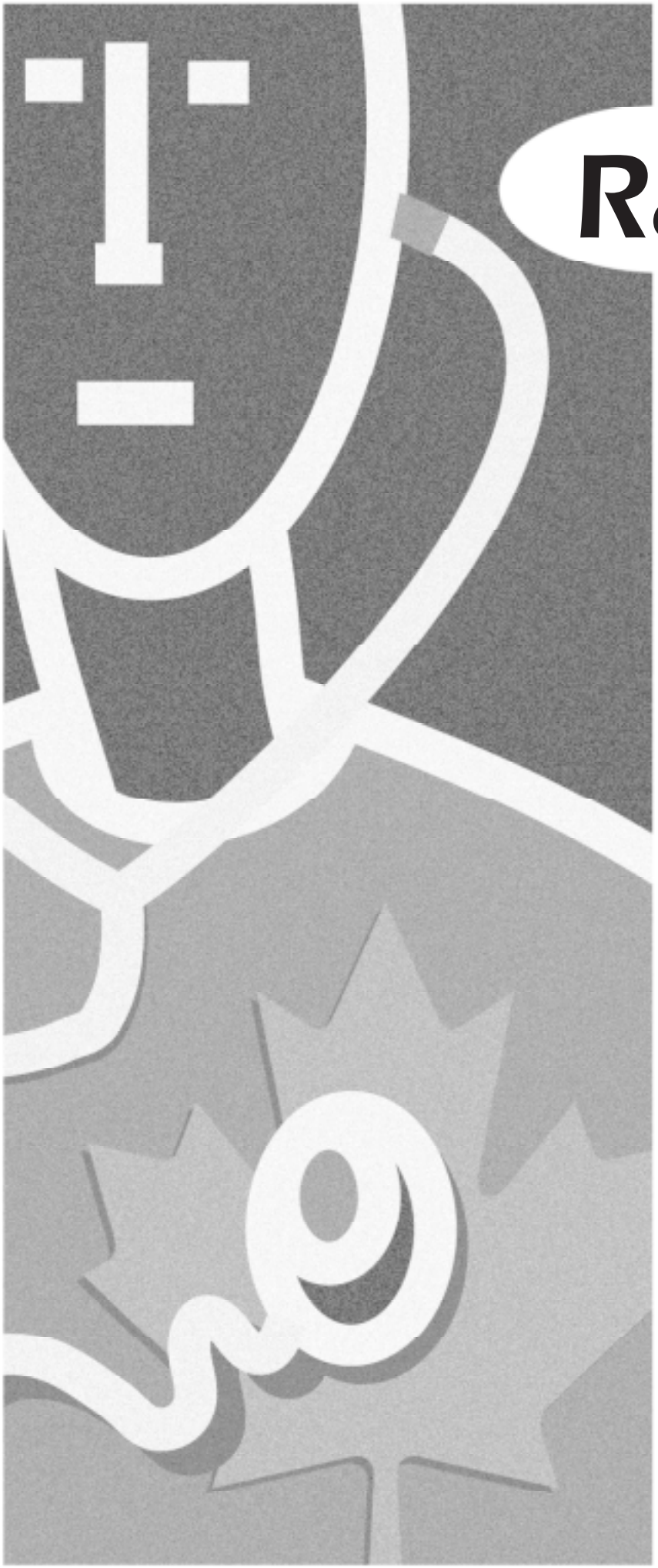


Research Articles

In-depth research and analysis in the fields of health and vital statistics

Mortality in metropolitan areas

Heather Gilmour and Jane F. Gentleman

Abstract

Objectives

This article examines differences in all causes mortality rates and rates for the leading causes of death (heart disease, cancer and cerebrovascular disease) by census metropolitan area (CMA).

Data source

The data are from the Canadian Vital Statistics Data Base maintained by Statistics Canada.

Analytical techniques

Annualized age-standardized mortality rates were calculated for Canada and for each CMA for the three-year period from 1994 to 1996. Differences between the CMA rates and the national rate were examined.

Main results

Mortality rates tend to be high in CMAs in the Atlantic provinces and Québec and low in CMAs in the Prairies and British Columbia. Ontario contains CMAs with some of the highest mortality rates in Canada, as well as others whose rates are among the lowest. The pattern of mortality for specific causes also differs within CMAs: a CMA may have a high death rate for one cause, but a low rate for another.

Key words

cause of death, death rate, urban health, heart diseases, neoplasms, cerebrovascular disease

Authors

Heather Gilmour (613-951-6610; gilmhea@statcan.ca) is with the Canadian Centre for Justice Statistics at Statistics Canada, Ottawa K1A 0T6. Jane F. Gentleman (301-436-7085; bzg5@cdc.gov), formerly with Statistics Canada, is currently with the Division of Health Interview Statistics, National Center for Health Statistics, Hyattsville, Maryland.

Big cities generally have a bad reputation. Pollution, noise, high stress levels, lack of space, and a hectic pace can all take a toll on an individual's health. Yet if mortality rates are any indication, the health of urban-dwellers varies sharply, depending on which city they call home.

Regional variations in mortality rates have been used as evidence of the importance of the social and physical environment to public health.[1] The spatial distribution of mortality rates may suggest the need for case detection and treatment programs, services and facilities. As well, to some degree, geographically based data indicate what is achievable. That is, particularly low mortality in one area suggests that improvements are feasible in regions where rates are elevated.[2]

Geographic variations in death rates have long been recognized. Decades ago in the United States, because of high cerebrovascular mortality rates, parts of the South became known as the "stroke belt."[3] In England and Wales, a gradient in mortality rates for most causes has been observed: high in the north and west, low in the south and east.[4] Canada, too, has a geographical gradient in

mortality, with higher rates in the Atlantic provinces and Québec than in the Prairie provinces and British Columbia.[1]

To a considerable extent, this east-to-west gradient may be strongly influenced by mortality rates in census metropolitan areas (CMAs). CMAs are large urban centres having at least 100,000 inhabitants in their central core. In 1996, 62% of Canadians lived in Canada's 25 CMAs, and CMAs accounted for 57% of deaths that occurred in the 1994-1996 period.

The demographic, socioeconomic and physical characteristics of CMAs differ. In 1996, populations ranged from 125,600 in Thunder Bay to 4.3 million in Toronto. Immigrants made up substantial shares of the populations of Toronto and Vancouver.[5] In Winnipeg, Saskatoon and Regina, Aboriginal people constituted a larger proportion of residents than was the case in other CMAs.[6] The industries that form the economic base of each CMA vary as well. For example, Calgary has long been the

Methods

Data sources

Mortality data are from the Canadian Vital Statistics Data Base, which compiles vital statistics submitted by the offices of vital statistics in each province and territory. Intercensal population estimates by age, sex and census metropolitan area (CMA) for 1995 were used to calculate the three-year average rates. The decedent's place of residence, not the place where the death occurred, was used to determine death rates for each CMA.

Analytical techniques

The 1991 population of Canada (all ages) was used as the standard population for calculation of age-standardized mortality rates. All mortality rates were age-adjusted using the direct method. Age-adjustment means that the rates are comparable across CMAs, despite local variations in age distribution. The standard population was not disaggregated by sex. It is, therefore, possible to compare age-standardized rates for males with age-standardized rates for females. Although mortality rates refer to the total population (from age 0), for readability, the terms "men" and "women" rather than "males" and "females" are used in this article.

Comparisons between areas may reflect random variation rather than real differences. Confidence intervals were calculated to assess the variation of each CMA's mortality rate. Two-sided tests were performed to identify statistically significant differences between the age-adjusted rate for each CMA and the age-adjusted national rate. Because the mortality rates for large CMAs can influence the national rate, these rates cannot be assumed to be independent of the national rate. To account for the degree of correlation between a given CMA's mortality rate and the national rate, estimated covariances were calculated between the two rates and were used in the calculation of the variance of the difference between rates.

Limitations

The data in this analysis should be interpreted with caution. CMAs are defined to represent economically and socially integrated areas (see *Definitions*). However, each CMA contains neighbourhoods whose social, economic and health characteristics vary widely. Thus, high or low mortality rates in specific parts of a CMA may be masked by the rates in the rest of the CMA.[7]

Because CMA boundaries must respect the administrative boundaries of census subdivisions (CSD), some CMAs include CSDs with large amounts of sparsely settled territory, and only the population closest to the urban core has a close relationship with that core.[8]

For most diseases, incidence rates provide the best measure of risk.[7] It is unclear how reliably mortality rates can be used as a measure of risk of disease in particular CMAs.[7]

The analysis excludes Prince Edward Island, the Northwest Territories and the Yukon, which have no CMAs. However, any analysis below the provincial/territorial level would be difficult in these regions because their death counts are low.

The 1991 Census population counts were adjusted for net undercoverage and for non-permanent residents. Subsequent investigation by officials at Statistics Canada revealed that the adjustment overcompensated for the undercount, resulting in figures that were too high. Therefore, population figures for 1986 to 1991 are being re-estimated by Statistics Canada. Mortality rates in this article were calculated before the revision at the CMA level, and thus may be slightly low. However, the impact of such adjustments should be small, and the underlying patterns should be similar, even after revision.

Because the law requires all deaths to be reported, the registration of deaths is considered virtually complete. Nonetheless, there are differences in diagnostic practices and coding procedures among provinces. Consequently, the specific cause of death category to which a given death is attributed may vary from one CMA to another. As well, a small number of late registrations may result in some underestimation of rates.

administrative hub of the country's oil and gas industry.[9] With seven degree-granting institutions, Halifax is Atlantic Canada's headquarters for education.[10] Ottawa-Hull, which encompasses the national capital, is the only CMA to cross provincial boundaries.

The unique character of CMAs extends to the death rates of their residents. Even in the same province, differences between CMAs can be pronounced. And within a single CMA, the death rate for one cause may be well above the national level, while the rate for another cause is below it.

This article focuses on three years of data (1994 to 1996) from the Canadian Vital Statistics Data Base to analyze mortality patterns in Canada's 25 CMAs (see *Methods* and *Definitions*). Age-standardized mortality rates for men and women for all causes of death are examined, as well as rates for the three leading causes: heart disease, cancer, and cerebrovascular disease (stroke). Lung cancer, the leading type of cancer, influences overall patterns of cancer mortality and, therefore, is analyzed separately.

Death rates are the ultimate outcome of a multitude of factors: socioeconomic, environmental, medical, and lifestyle. This article is a descriptive analysis only. It is beyond its scope to explore the reasons underlying the death rates in particular CMAs.

East-to-west decline

Mortality rates for the leading causes of death tend to be relatively high in the Atlantic provinces and Québec, and relatively low in western Canada. There are, however, some notable exceptions. The province of Québec has low rates of cerebrovascular mortality.[11] And in Manitoba, unlike the other western provinces, mortality rates for each of the leading causes match levels in eastern Canada.[11] To a great extent, provincial mortality rates are influenced by the CMAs, which are home to a substantial share of each province's population.

High rates in Atlantic CMAs

The high mortality rates that characterize the Atlantic provinces are influenced by the situation in the region's three CMAs: St. John's (Newfoundland), Saint John (New Brunswick) and Halifax (Nova Scotia).

All causes mortality rates in 1994-1996 were above the national level in each CMA, except for men in Halifax (Chart 1, Appendix Table A). In St. John's, this was the result of high mortality for heart disease, cancer (excluding lung) and cerebrovascular disease for both sexes, and lung cancer for men (Charts 2 to 5). Saint John, too, had high heart disease and lung cancer mortality rates, although rates for other cancers and cerebrovascular disease did not differ from the national level. Halifax residents had high lung cancer mortality rates, and among women, the rate for other cancers was also high. However, women in Halifax had a low mortality rate for cerebrovascular disease.

Definitions

All causes contributing to a death are entered on the death certificate in accordance with the Ninth Revision of the International Classification of Diseases (ICD-9).[12] A single underlying cause of death is coded. The following ICD-9 codes were used for this article: all causes (001-E999), lung cancer (162), other cancer (140-208, excluding 162), heart disease (391, 392.0, 393-398, 402, 404, 410-416, 420-429), and cerebrovascular disease (430-438). During the 1994-1996 period, heart disease and cancer together accounted for over half of all deaths for both sexes. Cerebrovascular disease, the third leading cause, made up an additional 7%.

Mortality counts: The number of deaths during the year attributed to a particular cause, based on the underlying cause of death.

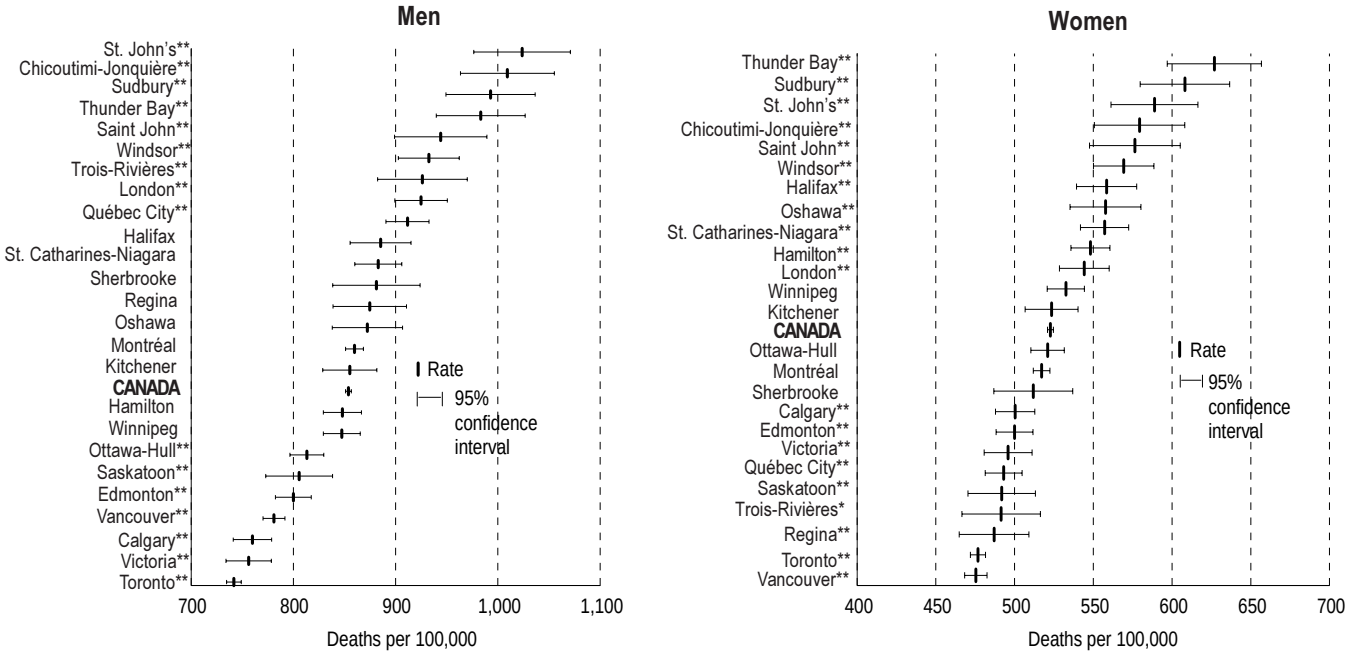
Underlying cause of death: The disease or injury that initiated the train of events leading directly to death, or the circumstances of the accident or violence that produced the fatal injury.[12]

Age-standardized mortality rate: The number of deaths per 100,000 population that would have occurred in the standard population (1991 Canadian population) if the actual age-specific rates observed in a given population had prevailed in the standard population.

Census metropolitan area (CMA): A large urban centre consisting of an urbanized core, with 100,000 or more inhabitants in that core (based on a previous census), and adjacent urban and rural areas that have a high degree of economic and social integration with the urbanized core. Once an area is designated a CMA, it maintains that status even if its core population falls below 100,000.[8]

Chart 1

Annualized age-standardized all causes mortality rate, by sex and census metropolitan area, 1994-1996



Data source: *Canadian Vital Statistics Data Base*

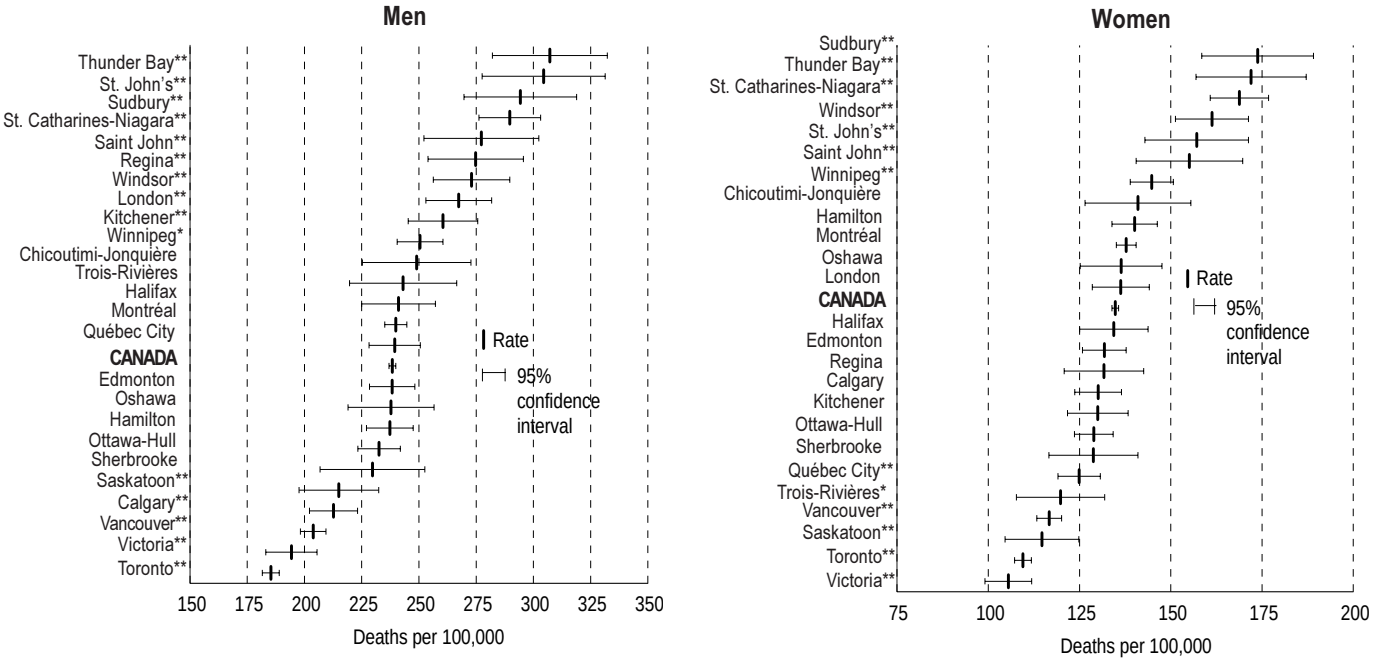
Note: *Rates are age-standardized to the 1991 Canadian population adjusted for net census undercoverage. To show the data more clearly, different scales are used for male and female mortality rates.*

** Significantly different from national rate ($p < 0.05$)*

*** Significantly different from national rate ($p < 0.01$)*

Chart 2

Annualized age-standardized heart disease mortality rate, by sex and census metropolitan area, 1994-1996



Data source: *Canadian Vital Statistics Data Base*

Note: *Rates are age-standardized to the 1991 Canadian population adjusted for net census undercoverage. To show the data more clearly, different scales are used for male and female mortality rates.*

** Significantly different from national rate ($p < 0.05$)*

*** Significantly different from national rate ($p < 0.01$)*

Cancer main factor in Québec

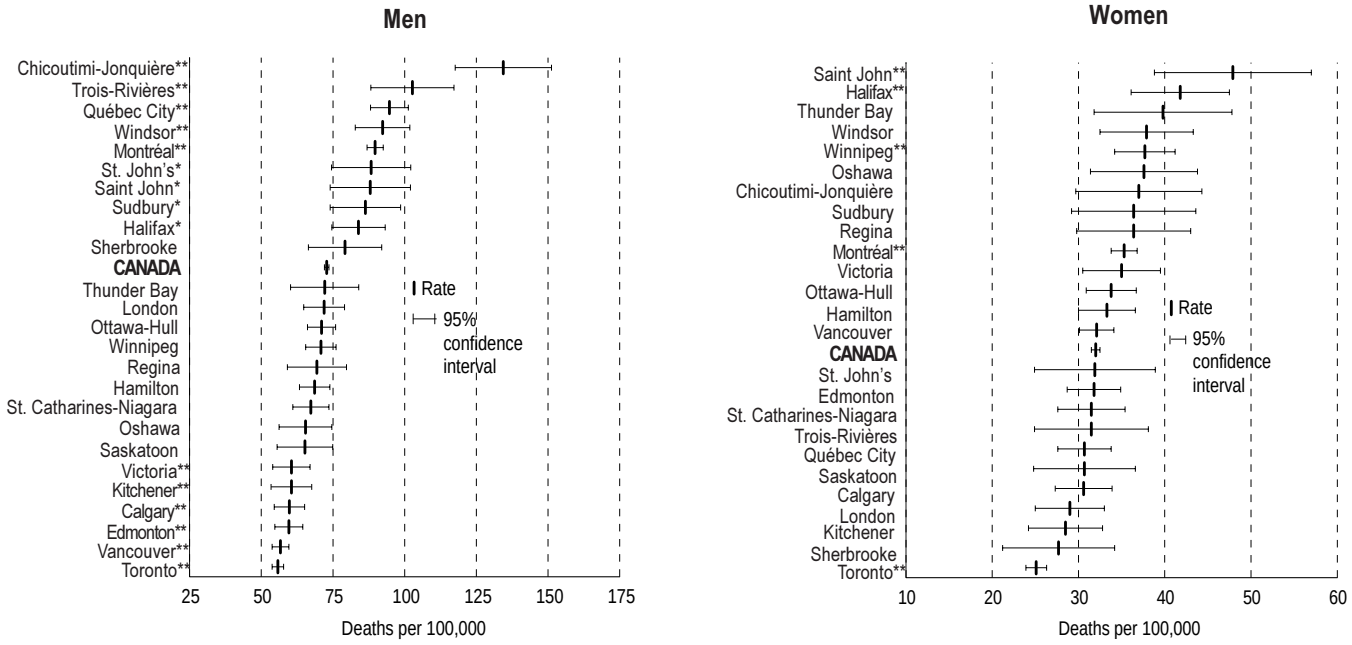
All causes male mortality rates were above the national level in three Québec CMAs: Chicoutimi-Jonquière, Trois-Rivières and Québec City. But in the province's other two CMAs, Sherbrooke and Montréal, rates were close to those for Canada as a whole. The high overall male mortality rates in Chicoutimi-Jonquière, Trois-Rivières and Québec City reflected high rates for lung cancer. Montréal men, too, had a high death rate from this disease. As well, male death rates from other forms of cancer were high in Chicoutimi-Jonquière, Québec City and Montréal. By contrast, heart disease death rates for men in the five Québec CMAs did not differ significantly from the national level. This was also true for cerebrovascular disease, except in Montréal, where the rate was low.

The pattern of mortality rates for women in Québec CMAs was different from that for men. The all causes rate was high only in Chicoutimi-Jonquière. In Sherbrooke and Montréal, rates were close to the national level, and in the two other Québec CMAs, rates were low. Chicoutimi-Jonquière's high overall female mortality rate reflected a high death rate for cancers other than lung. Montréal women had a high death rate for lung cancer. Montréal, in fact, was the only Québec CMA where female lung cancer mortality rates were significantly different from the national rate. By contrast, Montréal women, like men, had a low cerebrovascular mortality rate. Low all causes mortality for women in Québec City and Trois-Rivières mirrored low rates for heart disease, and in Québec City, for cerebrovascular disease as well.

Mixed pattern in Ontario

In 1994-1996, mortality rates in some Ontario CMAs were among the highest in the country, while rates in others were among the lowest.

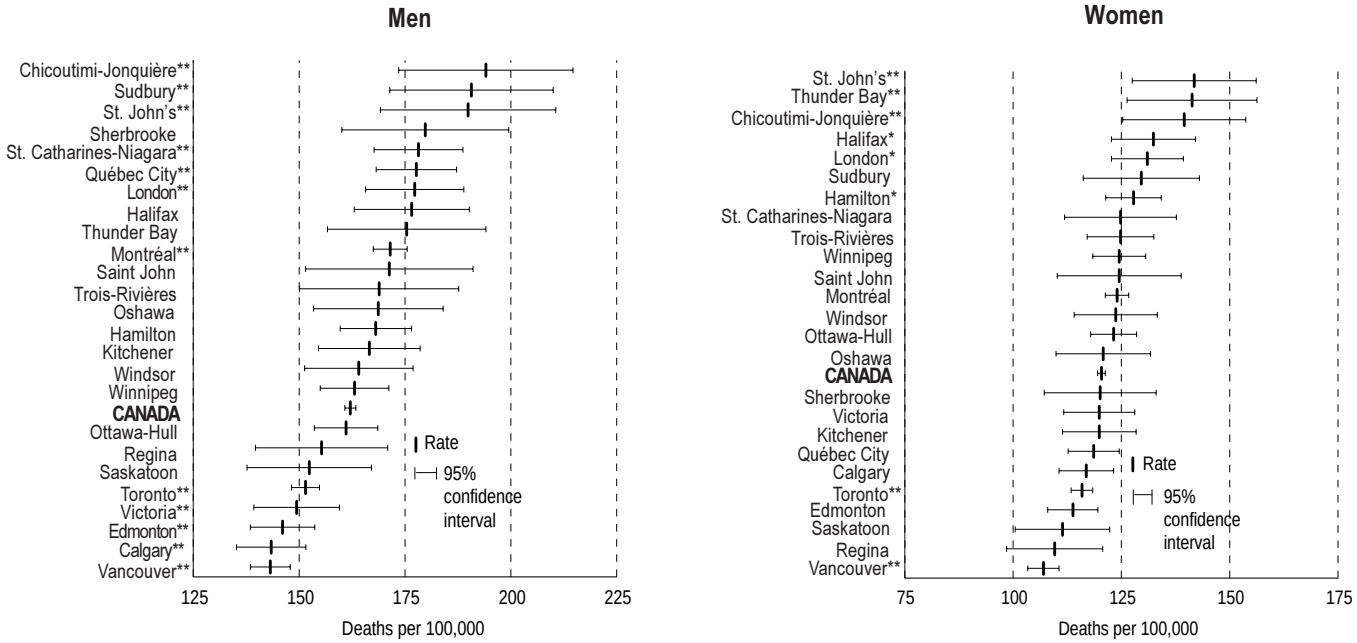
Chart 3
Annualized age-standardized lung cancer mortality rate, by sex and census metropolitan area, 1994-1996



Data source: *Canadian Vital Statistics Data Base*
Note: *Rates are age-standardized to the 1991 Canadian population adjusted for net census undercoverage. To show the data more clearly, different scales are used for male and female mortality rates.*
** Significantly different from national rate ($p < 0.05$)*
*** Significantly different from national rate ($p < 0.01$)*

Chart 4

Annualized age-standardized cancer (excluding lung) mortality rate, by sex and census metropolitan area, 1994-1996



Data source: *Canadian Vital Statistics Data Base*

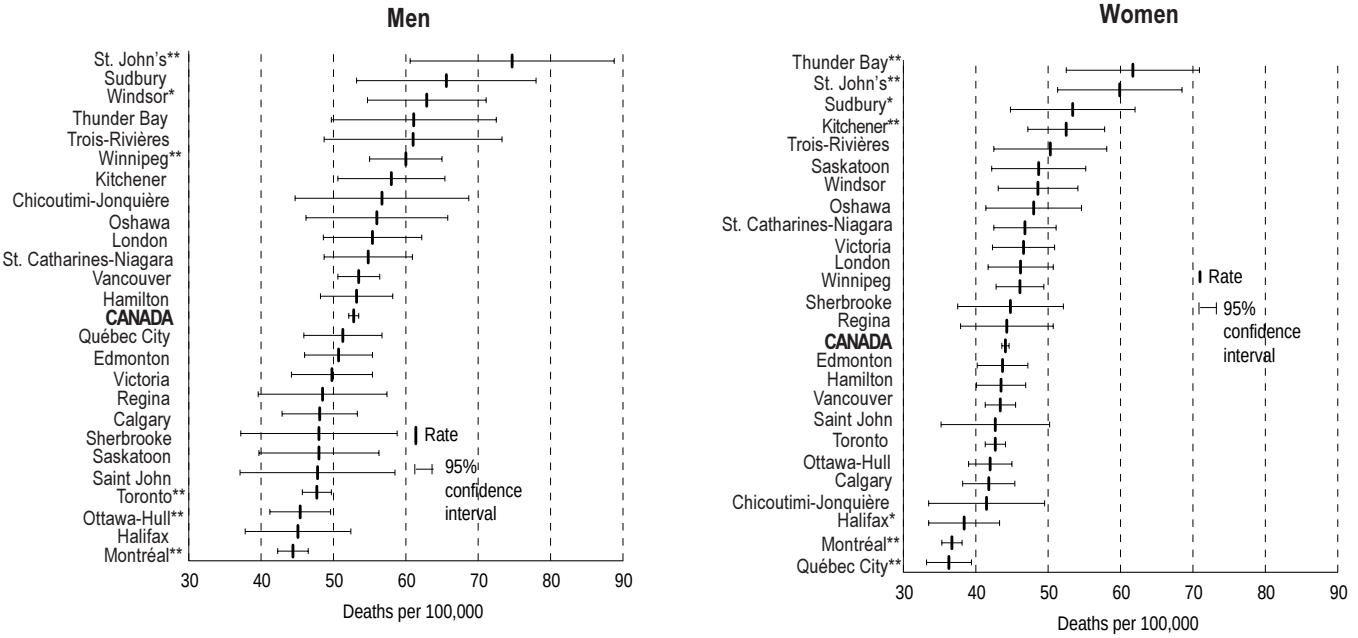
Note: *Rates are age-standardized to the 1991 Canadian population adjusted for net census undercoverage. To show the data more clearly, different scales are used for male and female mortality rates.*

** Significantly different from national rate ($p < 0.05$)*

*** Significantly different from national rate ($p < 0.01$)*

Chart 5

Annualized age-standardized cerebrovascular disease mortality rate, by sex and census metropolitan area, 1994-1996



Data source: *Canadian Vital Statistics Data Base*

Note: *Rates are age-standardized to the 1991 Canadian population adjusted for net census undercoverage.*

** Significantly different from national rate ($p < 0.05$)*

*** Significantly different from national rate ($p < 0.01$)*

For men, all causes mortality was high in Sudbury, Thunder Bay, Windsor and London. Each of these CMAs had high heart disease mortality rates. In Sudbury, male mortality was also high for cancer (lung and other forms). Windsor's male death rates for lung cancer and cerebrovascular disease were high, as were rates for cancers other than lung among men in London. In St. Catharines-Niagara and Kitchener, men's heart disease death rates were high. Men in St. Catharines-Niagara also had a high death rate for cancers other than lung. In Kitchener, male lung cancer mortality was low.

Ottawa-Hull and Toronto had low overall male mortality rates. Toronto's rates for each of the leading causes of death were all low. Men in Ottawa-Hull had low mortality from cerebrovascular disease.

For women in Ontario CMAs, the all causes mortality rate was high in Thunder Bay, Sudbury, Windsor, Oshawa, St. Catharines-Niagara, Hamilton and London. Heart disease death rates were high in Sudbury, Thunder Bay, St. Catharines-Niagara and Windsor. Female lung cancer mortality rates were not significantly different from the national rate in any Ontario CMA, except Toronto, where the rate was low. Women in Thunder Bay, London and Hamilton had high death rates from other forms of cancer. Mortality from cerebrovascular disease was high for women in Thunder Bay, Sudbury and Kitchener.

Toronto, alone among Ontario CMAs, had low all causes female mortality in 1994-1996. This reflected low mortality rates for heart disease and cancer.

Rates low in western CMAs

Mortality rates among residents of CMAs in the western provinces tended to be low in 1994-1996, often well below national rates.

Among men, all causes mortality was below the national level in Saskatoon, Edmonton, Calgary Vancouver and Victoria. Except for Edmonton, men in these CMAs had low heart disease death rates. Cancer mortality was low for men in Edmonton, Calgary, Vancouver and Victoria. By contrast, men in Regina and Winnipeg had high heart disease mortality, and those in Winnipeg also had high cerebrovascular disease mortality.

For women, overall mortality rates were low in each western CMA except Winnipeg, where the rate did not differ significantly from the national level. Winnipeg was the only western CMA with high female mortality for any of the leading causes of death: heart disease and lung cancer. By contrast, female mortality rates for heart disease were low in Saskatoon, Vancouver and Victoria. The rate for cancers other than lung was low in Vancouver.

Concluding remarks

The east-to-west gradient in Canada's mortality rates largely reflects the situation in CMAs, which contain the majority of the population and account for well over half of all deaths. However, reasons for the sharp variations between CMAs are complex and based on multiple factors. Such differences may result from a joint effect of socioeconomic and environmental conditions.

Migration may play a role as well. Between 1991 and 1996, close to a quarter of Canadians moved to another municipality, either within the same province or to a different province.[13] Migrants tend to be young, well-educated, relatively healthy individuals.[13] By moving, they may leave behind a higher proportion of older, less educated, and perhaps, less healthy people. Thus, an influx of migrants to a CMA could lower mortality rates there. Conversely, a CMA losing mobile—and healthy—people might see an upturn in mortality rates.

In some cases, the effect of migration on mortality rates may have to do not so much with the net gain or loss of residents, but with the nature of the migrants, specifically immigrants, who tend to settle in the largest CMAs. For example, Toronto and Vancouver stand out as CMAs with low mortality rates. Both cities have received large numbers of immigrants in recent years, so the "healthy immigrant effect" may be a factor.[14] Healthy people are more inclined to immigrate than those in poor health, and immigrants must undergo medical screening before they enter the country. Consequently, as a group, immigrants tend to be relatively healthy and are likely to have a positive influence on the overall health of any community.

But the impact of migration and immigration on a CMA's mortality rates may also be to obscure the effects of local conditions. The population at risk in any CMA includes people who lived elsewhere for various periods of time. Since many diseases that ultimately end in death take years to develop, it is difficult to determine where an individual was exposed to risk factors.[7] Therefore, a high mortality rate in a given CMA cannot be interpreted as indicating the true presence of health problems, nor is it sufficient evidence to implicate specific causal factors, such as environment or occupation in a disease.[1,7] In addition, some migration may actually be the result of illness. For instance, people with chronic conditions may relocate to large centres to be near treatment, and therefore, could inflate mortality rates in some CMAs.

Differences in mortality rates for various CMAs may be partially attributable to differences in lifestyle, particularly smoking. CMAs in Atlantic Canada and Québec, which tend to have high lung cancer mortality rates, also have high smoking prevalence.[15]

Thus, while geographic patterns show differences in mortality rates between large urban centres, it is very difficult to pinpoint a specific reason for particularly high or low mortality rates in a given CMA. Most likely, the reasons stem from complex interactions between a number of factors. Nonetheless, the wide ranges between the CMAs with the highest and lowest mortality rates suggest that there may be some potential for lowering mortality in a number of urban areas.[2] Public health strategies to reduce the prevalence of known modifiable risk factors may be particularly beneficial in CMAs with high mortality rates for specific causes of death.

References

1 Health and Welfare Canada and Statistics Canada. *Mortality Atlas of Canada. Volume 4. General Mortality Patterns and Recent Trends* (Catalogue H49-6/4-1990) Ottawa: Minister of Supply and Services Canada, 1991.

2 Wong T, Wilkins K. How many deaths from major chronic diseases could be prevented? *Chronic Diseases in Canada* 1990; 11(5): 73-6.

3 Pickle LW, Mungiole M, Jones GK, et al. *Atlas of United States Mortality* (DHHS Publication No. (PHS) 97-1015) Hyattsville, Maryland: U.S. Department of Health and Human Services, 1996.

4 Britton M. Geographic variation in mortality, 1973-83. In: Britton M, ed. *Mortality and Geography. A Review in the Mid-1980s, England and Wales.* London: Office of Population Censuses and Surveys, 1990.

5 Statistics Canada. 1996 Census: Immigration and citizenship. *The Daily* (Catalogue 11-001E) Tuesday, November 4, 1997.

6 Statistics Canada. 1996 Census: Aboriginal data. *The Daily* (Catalogue 11-001E) Tuesday, January 13, 1998.

7 Health and Welfare Canada and Statistics Canada. *Mortality Atlas of Canada, Volume 5, Seniors' Mortality* (Catalogue H49-6/5-1996) Ottawa: Minister of Supply and Services Canada, 1995.

8 Statistics Canada. *1996 Census Dictionary* (Catalogue 92-351-XPE) Ottawa: Industry Canada, 1997.

9 Stone N. Calgary: A statistical profile. *Canadian Social Trends* (Catalogue 11-008) 1987; Winter: 19-23.

10 Peters A. The historic city of Halifax. *Canadian Social Trends* (Statistics Canada, Catalogue 11-008-XPE) 1997; Summer: 8-12.

11 Statistics Canada. *Causes of Death* (Catalogue 84-208-XPB) Ottawa: Industry Canada, 1995.

12 World Health Organization. *Manual of the International Statistical Classification of Diseases, Injuries and Causes of Death.* Based on the Recommendations of the Ninth Revision Conference, 1975. Geneva: World Health Organization, 1977.

13 Statistics Canada. 1996 Census: Education, mobility and migration. *The Daily* (Statistics Canada, Catalogue 11-001E), Tuesday, April 14, 1998.

14 Chen J, Wilkins R, Ng E. The health of Canada's immigrants in 1994-95. *Health Reports* (Catalogue 82-003) 1995; 7(4): 33-45.

15 Stephens M, Siroonian J. Smoking prevalence, quit attempts and successes. *Health Reports* (Statistics Canada, Catalogue 82-003) 1998; 9(4): 31-7.

Appendix

Table A
Annualized age-standardized mortality rate, selected causes, by sex and census metropolitan area, 1994-1996

	Men			Women	
	Rate	95% confidence interval		Rate	95% confidence interval
All causes					
St. John's	1,023.7**	976.5, 1,070.9	Thunder Bay	626.9**	597.0, 656.8
Chicoutimi-Jonquière	1,009.3**	963.4, 1,055.2	Sudbury	608.2**	579.8, 636.6
Sudbury	992.9**	949.3, 1,036.5	St. John's	588.9**	561.3, 616.5
Thunder Bay	983.2**	939.7, 1,026.7	Chicoutimi-Jonquière	579.4**	550.7, 608.1
Saint John	944.1**	898.9, 989.3	Saint John	576.4**	547.6, 605.2
Windsor	932.5**	902.7, 962.3	Windsor	569.3**	550.1, 588.5
Trois-Rivières	926.2**	882.4, 970.0	Halifax	558.5**	539.4, 577.6
London	924.9**	899.3, 950.5	Oshawa	557.8**	535.3, 580.3
Québec City	911.6**	890.6, 932.6	St. Catharines-Niagara	557.2**	541.9, 572.5
Halifax	885.3	855.5, 915.1	Hamilton	548.2**	535.8, 560.6
St. Catharines-Niagara	883.0	860.0, 906.0	London	544.3**	528.5, 560.1
Sherbrooke	881.2	838.5, 923.9	Winnipeg	532.6	520.8, 544.4
Regina	874.7	838.8, 910.6	Kitchener	523.5	506.7, 540.3
Oshawa	872.4	838.0, 906.8	**Canada**	**522.8**	**520.9, 524.7**
Montréal	859.8	851.1, 868.5	Ottawa-Hull	521.0	510.4, 531.6
Kitchener	855.2	828.7, 881.7	Montréal	517.2	511.9, 522.5
Canada	**853.9**	**851.1, 856.7**	Sherbrooke	511.9	486.8, 537.0
Hamilton	847.9	829.3, 866.5	Calgary	500.4**	487.9, 512.9
Winnipeg	847.4	829.4, 865.4	Edmonton	500.0**	488.3, 511.7
Ottawa-Hull	813.2**	796.6, 829.8	Victoria	495.9**	480.7, 511.1
Saskatoon	805.7**	773.0, 838.4	Québec City	493.1**	481.4, 504.8
Edmonton	800.0**	782.5, 817.5	Saskatoon	491.8**	470.4, 513.2
Vancouver	781.0**	770.3, 791.7	Trois-Rivières	491.5*	466.6, 516.4
Calgary	760.0**	741.2, 778.8	Regina	487.0**	464.9, 509.1
Victoria	756.3**	734.1, 778.5	Toronto	476.8**	472.0, 481.6
Toronto	741.8**	734.6, 749.0	Vancouver	475.4**	468.3, 482.5
Heart disease					
Thunder Bay	307.2**	282.1, 332.3	Sudbury	173.8**	158.5, 189.1
St. John's	304.5**	277.6, 331.4	Thunder Bay	172.0**	156.9, 187.1
Sudbury	294.3**	269.7, 318.9	St. Catharines-Niagara	168.8**	160.8, 176.8
St. Catharines-Niagara	289.7**	276.2, 303.2	Windsor	161.3**	151.3, 171.3
Saint John	277.3**	252.2, 302.4	St. John's	157.1**	142.9, 171.3
Regina	274.8**	254.0, 295.6	Saint John	155.1**	140.5, 169.7
Windsor	273.0**	256.3, 289.7	Winnipeg	144.8**	138.9, 150.7
London	267.4**	253.0, 281.8	Chicoutimi-Jonquière	141.0	126.5, 155.5
Kitchener	260.5**	245.3, 275.7	Hamilton	140.1	133.9, 146.3
Winnipeg	250.5*	240.5, 260.5	Montréal	137.8	135.1, 140.5
Chicoutimi-Jonquière	249.0	225.3, 272.7	Oshawa	136.4	125.2, 147.6
Trois-Rivières	243.1	219.7, 266.5	London	136.3	128.5, 144.1
Halifax	241.1	225.0, 257.2	**Canada**	**134.8**	**133.9, 135.7**
Montréal	239.9	235.1, 244.7	Halifax	134.4	125.0, 143.8
Québec City	239.4	228.2, 250.6	Edmonton	131.8	125.8, 137.8
Canada	**238.4**	**236.9, 239.9**	Regina	131.7	120.8, 142.6
Edmonton	238.3	228.4, 248.2	Calgary	130.1	123.7, 136.5
Oshawa	237.8	219.0, 256.6	Kitchener	130.0	121.7, 138.3
Hamilton	237.3	227.1, 247.5	Ottawa-Hull	128.9	123.6, 134.2
Ottawa-Hull	232.6	223.3, 241.9	Sherbrooke	128.8	116.6, 141.0
Sherbrooke	229.7	206.8, 252.6	Québec City	124.9**	119.1, 130.7
Saskatoon	215.0**	197.6, 232.4	Trois-Rivières	119.8*	107.7, 131.9
Calgary	212.7**	202.2, 223.2	Vancouver	116.7**	113.3, 120.1
Vancouver	203.8**	198.2, 209.4	Saskatoon	114.7**	104.6, 124.8
Victoria	194.3**	183.1, 205.5	Toronto	109.5**	107.2, 111.8
Toronto	185.3**	181.6, 189.0	Victoria	105.5**	99.1, 111.9

Annualized age-standardized mortality rate, selected causes, by sex and census metropolitan area, 1994-1996 – continued

	Men			Women	
	Rate	95% confidence interval		Rate	95% confidence interval
Lung cancer					
Chicoutimi-Jonquière	134.4**	117.6, 151.2	Saint John	47.9**	38.8, 57.0
Trois-Rivières	102.7**	88.2, 117.2	Halifax	41.8**	36.1, 47.5
Québec City	94.7**	88.1, 101.3	Thunder Bay	39.8	31.8, 47.8
Windsor	92.3**	82.8, 101.8	Windsor	37.9	32.5, 43.3
Montréal	89.7**	86.9, 92.5	Winnipeg	37.7**	34.2, 41.2
St. John's	88.3*	74.5, 102.1	Oshawa	37.6	31.4, 43.8
Saint John	88.0*	74.0, 102.0	Chicoutimi-Jonquière	37.0	29.7, 44.3
Sudbury	86.3*	74.0, 98.6	Sudbury	36.4	29.2, 43.6
Halifax	83.9*	74.6, 93.2	Regina	36.4	29.8, 43.0
Sherbrooke	79.2	66.4, 92.0	Montréal	35.3**	33.8, 36.8
Canada	**72.8**	**72.0, 73.6**	Victoria	35.0	30.5, 39.5
Thunder Bay	72.1	60.2, 84.0	Ottawa-Hull	33.8	30.9, 36.7
London	71.9	64.8, 79.0	Hamilton	33.3	30.0, 36.6
Ottawa-Hull	71.0	66.1, 75.9	Vancouver	32.1	30.1, 34.1
Winnipeg	70.8	65.5, 76.1	**Canada**	**32.0**	**31.5, 32.5**
Regina	69.4	59.1, 79.7	St. John's	31.9	24.9, 38.9
Hamilton	68.6	63.3, 73.9	Edmonton	31.8	28.7, 34.9
St. Catharines-Niagara	67.3	61.0, 73.6	St. Catharines-Niagara	31.5	27.6, 35.4
Oshawa	65.4	56.2, 74.6	Trois-Rivières	31.5	24.9, 38.1
Saskatoon	65.2	55.5, 74.9	Québec City	30.7	27.6, 33.8
Victoria	60.5**	54.0, 67.0	Saskatoon	30.7	24.8, 36.6
Kitchener	60.5**	53.4, 67.6	Calgary	30.6	27.3, 33.9
Calgary	59.8**	54.5, 65.1	London	29.0	25.0, 33.0
Edmonton	59.6**	54.7, 64.5	Kitchener	28.5	24.2, 32.8
Vancouver	56.7**	53.8, 59.6	Sherbrooke	27.7	21.2, 34.2
Toronto	55.8**	53.8, 57.8	Toronto	25.1**	23.9, 26.3
Other cancer					
Chicoutimi-Jonquière	194.1**	173.5, 214.7	St. John's	141.8**	127.5, 156.1
Sudbury	190.7**	171.4, 210.0	Thunder Bay	141.3**	126.3, 156.3
St. John's	189.9**	169.2, 210.6	Chicoutimi-Jonquière	139.5**	125.3, 153.7
Sherbrooke	179.8	160.1, 199.5	Halifax	132.4*	122.7, 142.1
St. Catharines-Niagara	178.2**	167.7, 188.7	London	131.0*	122.7, 139.3
Québec City	177.7**	168.2, 187.2	Sudbury	129.6	116.2, 143.0
London	177.3**	165.7, 188.9	Hamilton	127.8*	121.4, 134.2
Halifax	176.6	163.0, 190.2	St. Catharines-Niagara	124.8	117.1, 132.5
Thunder Bay	175.4	156.7, 194.1	Trois-Rivières	124.8	111.9, 137.7
Montréal	171.5**	167.5, 175.5	Winnipeg	124.5	118.4, 130.6
Saint John	171.3	151.5, 191.1	Saint John	124.5	110.2, 138.8
Trois-Rivières	168.9	150.1, 187.7	Montréal	124.0	121.3, 126.7
Oshawa	168.7	153.4, 184.0	Windsor	123.7	114.1, 133.3
Hamilton	168.1	159.7, 176.5	Ottawa-Hull	123.2	117.9, 128.5
Kitchener	166.6	154.6, 178.6	Oshawa	120.8	109.9, 131.7
Windsor	164.1	151.3, 176.9	**Canada**	**120.4**	**119.5, 121.3**
Winnipeg	163.1	155.0, 171.2	Sherbrooke	120.1	107.2, 133.0
Canada	**162.1**	**160.8, 163.4**	Victoria	119.9	111.7, 128.1
Ottawa-Hull	161.1	153.6, 168.6	Kitchener	119.9	111.4, 128.4
Regina	155.3	139.7, 170.9	Québec City	118.6	112.7, 124.5
Saskatoon	152.4	137.7, 167.1	Calgary	116.9	110.6, 123.2
Toronto	151.5**	148.2, 154.8	Toronto	115.9**	113.4, 118.4
Victoria	149.4**	139.3, 159.5	Edmonton	113.8	108.0, 119.6
Edmonton	146.1**	138.5, 153.7	Saskatoon	111.4	100.5, 122.3
Calgary	143.4**	135.2, 151.6	Regina	109.6	98.5, 120.7
Vancouver	143.2**	138.5, 147.9	Vancouver	107.0**	103.4, 110.6

Annualized age-standardized mortality rate, selected causes, by sex and census metropolitan area, 1994-1996 – concluded

	Men			Women	
	Rate	95% confidence interval		Rate	95% confidence interval
Cerebrovascular disease					
St. John's	74.7**	60.6, 88.8	Thunder Bay	61.7**	52.5, 70.9
Sudbury	65.6	53.2, 78.0	St. John's	59.9**	51.3, 68.5
Windsor	62.9*	54.7, 71.1	Sudbury	53.4*	44.8, 62.0
Thunder Bay	61.1	49.7, 72.5	Kitchener	52.5**	47.2, 57.8
Trois-Rivières	61.0	48.7, 73.3	Trois-Rivières	50.3	42.5, 58.1
Winnipeg	60.0**	55.0, 65.0	Saskatoon	48.7	42.2, 55.2
Kitchener	58.0	50.6, 65.4	Windsor	48.6	43.1, 54.1
Chicoutimi-Jonquière	56.7	44.7, 68.7	Oshawa	48.0	41.4, 54.6
Oshawa	56.0	46.2, 65.8	St. Catharines-Niagara	46.8	42.5, 51.1
London	55.4	48.6, 62.2	Victoria	46.6	42.3, 50.9
St. Catharines-Niagara	54.8	48.7, 60.9	London	46.2	41.7, 50.7
Vancouver	53.5	50.6, 56.4	Winnipeg	46.1	42.8, 49.4
Hamilton	53.2	48.2, 58.2	Sherbrooke	44.8	37.5, 52.1
Canada	**52.8**	**52.1, 53.5**	Regina	44.3	37.9, 50.7
Québec City	51.3	45.9, 56.7	**Canada**	**44.1**	**43.6, 44.6**
Edmonton	50.7	46.0, 55.4	Edmonton	43.7	40.2, 47.2
Victoria	49.8	44.2, 55.4	Hamilton	43.5	40.1, 46.9
Regina	48.5	39.6, 57.4	Vancouver	43.4	41.3, 45.5
Calgary	48.1	42.9, 53.3	Saint John	42.7	35.2, 50.2
Sherbrooke	48.0	37.2, 58.8	Toronto	42.7	41.3, 44.1
Saskatoon	48.0	39.7, 56.3	Ottawa-Hull	42.0	39.0, 45.0
Saint John	47.8	37.1, 58.5	Calgary	41.8	38.2, 45.4
Toronto	47.7**	45.7, 49.7	Chicoutimi-Jonquière	41.5	33.5, 49.5
Ottawa-Hull	45.4**	41.2, 49.6	Halifax	38.4*	33.5, 43.3
Halifax	45.1	37.8, 52.4	Montréal	36.7**	35.3, 38.1
Montréal	44.4**	42.3, 46.5	Québec City	36.3**	33.2, 39.4

Data source: *Canadian Vital Statistics Data Base*

Note: *Rates are age-standardized to the 1991 Canadian population adjusted for net census undercoverage.*

** Significantly different from national rate ($p < 0.05$)*

*** Significantly different from national rate ($p < 0.01$)*

Health effects of physical activity

Jiajian Chen and Wayne J. Millar

Abstract

Objectives

This article examines the potential protective effect of leisure-time physical activity on the incidence of heart disease and depression.

Data source

The data are from the household longitudinal component of the 1994/95 and 1996/97 cycles of the National Population Health Survey, conducted by Statistics Canada. Results are based on two sub-samples: 7,158 respondents aged 20 or older who were healthy and free of heart disease in 1994/95, and 7,593 respondents aged 12 or older who were healthy and free of depression in 1994/95.

Analytical techniques

Multiple logistic regression was used to estimate the effects of leisure-time physical activity on the incidence of heart disease and depression, while controlling for selected characteristics.

Main results

Individuals who were healthy and free of heart disease or depression in 1994/95 and who engaged in regular physical activity at a moderate level of energy expenditure had lower odds of reporting a diagnosis of heart disease or an episode of depression in 1996/97 than those who were less active.

Key words

cardiovascular disease, depression, energy expenditure

Authors

Jiajian Chen (613-951-5059; chenjia@statcan.ca) and Wayne J. Millar (613-951-1631; millway@statcan.ca) are with the Health Statistics Division at Statistics Canada, Ottawa K1A 0T6.

The trend toward the automation of many physically demanding tasks has reduced the overall level of energy expenditure both at work and at home. In 1996/97, most Canadians aged 12 or older (95%) engaged in only light physical efforts in their daily activities.[1] While the reduction of everyday physical demands may have made life easier, it may also pose a challenge to the prevention of some chronic diseases and the maintenance of health.[2,3]

Widespread evidence indicates that regular physical activity has both physical and mental health benefits, including the prevention of heart disease and depression.[2-9] Heart disease is a leading cause of death, disability and illness, and one of the major costs of health care in Canada.[10] Depression is a common psychiatric disorder, and another major cause of hospitalization and disability.[3,8,11]

Early studies often emphasized vigorous and continuous exercise as key to improvements in health. However, more recent studies have suggested that moderate physical activity can also provide clinically significant health benefits.[2,3,12-17] Longitudinal data from the first two cycles of the National

Population Health Survey (1994/95 and 1996/97) present a unique opportunity to examine the potentially protective effect of leisure-time physical activity on heart disease and depression among representative samples of the general population (see *Methods*, *Definitions* and *Limitations*).

Level and frequency of activity

According to cross-sectional data from the 1994/95 NPHS, over half (58%) of Canadians aged 12 or older were physically inactive during their leisure time; that is, their activities required a *low* level of energy expenditure (see *Defining physical activity*). Another 22% reported activities that required *medium* energy expenditure. Just 20% had activities that involved a *high* level of energy expenditure. Little change was seen in 1996/97 (data not shown).

The situation was similar among the Canadians who were selected for this follow-up study. Among those who were aged 20 or older and free of heart

Methods

Data source

This article is based on Statistics Canada's National Population Health Survey (NPHS). The NPHS, which began in 1994/95, collects information about the health of the Canadian population every two years.[18,19] It covers household and institutional residents in all provinces and territories, except persons living on Indian reserves, on Canadian Forces bases, and in some remote areas. The NPHS has both a longitudinal and a cross-sectional component. Respondents who are part of the longitudinal component will be followed for up to 20 years.

Individual data are organized into two files: General and Health. Socio-demographic and some health information was obtained for each member of participating households. These data are found in the General file. Additional in-depth health information was collected for one randomly selected household member. The in-depth health information, as well as the information on the General file pertaining to that individual, is found in the Health file.

Among individuals in the longitudinal component, the person providing in-depth health information about himself or herself for the Health file was the randomly selected person for that household in cycle 1 (1994/95) and was usually the person who provided information on all household members for the General file in cycle 2.

The 1994/95 provincial, non-institutional sample consisted of 27,263 households, of which 88.7% agreed to participate in the survey. After the application of a screening rule to keep the sample representative,[18] 20,725 households remained. In 18,342 of these households, the randomly selected person was aged 12 or older. Their response rate to the in-depth health questions was 96.1%, or 17,626 respondents. Of these 17,626 randomly selected respondents, 14,786 were eligible members of the NPHS longitudinal panel. In addition, 468 persons for whom only general information was collected in 1994/95 and 2,022 of the 2,383 randomly selected respondents under age 12 were also eligible. Thus, 17,276 respondents were eligible for re-interview in 1996/97. The remaining respondents were sponsored by provincial governments that elected to enlarge the sample size in their province for cycle 1 only. These respondents were not followed up.

For the longitudinal panel, a response rate of 93.6% was achieved in 1996/97. Of these 16,168 respondents, full information was available for 15,670; that is, general and in-depth health information for both cycles of the survey.

This analysis of leisure-time physical activity and health is based on longitudinal data from the household component of the first (1994/95) and second (1996/97) cycles of the NPHS for the 10 provinces.

To study the incidence of heart disease and depression, the analysis was restricted to 7,158 respondents aged 20 or older who were healthy (that is, they reported their health to be excellent or very good) and free of heart disease in 1994/95 and 7,593 respondents aged 12 or older who were healthy and free of depression in 1994/95. Because of the very low incidence of heart disease among those younger than 20 in 1994/95, this group was excluded from the analysis of heart disease. Those who reported their general health status as poor, fair, or good in 1994/95 were excluded from both analyses to minimize the potential selection bias toward low-level activity as a result of undetected or undiagnosed disease. This approach may reduce selection bias as a possible explanation of the association between physical activity and health. The examination of depression, however, may include individuals with chronic or recurrent depression.[20]

Analytical techniques

The analysis was based on a weighted sample to represent the total household population in the 10 provinces. Multiple logistic regression was used to study the effect of physical activity while controlling for a number of possible confounding factors. The standard errors of regression coefficients were calculated using the bootstrap technique,[21-23] which fully accounts for the design effects of the NPHS.

disease in 1994/95, 57% engaged in leisure-time physical activity with *low* energy expenditure, as did 54% of the population aged 12 or older who were free of depression (Appendix Table A).

About 6 in 10 of the healthy Canadians examined in this article participated in *regular* physical activity. The remaining 40% engaged in physical activity only irregularly.

For this analysis, the reported level and frequency of leisure-time physical activities were combined into four categories: active (high/regular), moderate (medium/regular), light (low/regular) and sedentary (irregular regardless of energy expenditure). In 1994/95, 18% of the population aged 20 or older were active; 22%, moderate; and 15%, light. The largest single group, however, accounting for 40%, were sedentary (Appendix Table B). Reflecting the higher levels of energy expenditure at younger ages, among the population aged 12 or older, the active percentage was slightly greater (22%), although the sedentary percentage was the same (40%).

Incidence of heart disease

The age-adjusted two-year incidence of heart disease declined with increasing physical activity, from 2.3% for individuals who were sedentary in their leisure time to less than 1% for those who were moderate or active (Chart 1, Appendix Table B). The incidence of heart disease also varied by age, education, household income, activity limitation, smoking status, high blood pressure, and body mass index.[10,26,27] Yet even after adjusting for these risk factors, the odds of two-year incidence of heart disease were higher for those in the less active groups (Table 1). The adjusted odds of having heart disease were significantly high for those in the light and sedentary groups (3.7 and 5.0, respectively), compared with the moderate group. The odds were

Defining physical activity

In the National Population Health Survey (NPHS), the *level* (or amount) of physical activity was defined based on total accumulated energy expenditure, or EE, during leisure time. Information about energy expenditure at work was not available. The EE values were calculated using the frequency and duration of all of the respondents' leisure-time activities in the previous three months as well as the MET values of these activities. MET values, which are the metabolic energy demand of each activity, were independently established.[24,25]

$$EE = \sum(N_i * D_i * METS_i / 365)$$

where

N_i = number of occasions of activity i in a year

D_i = average duration in hours of activity i

$METS_i$ = a constant value for metabolic energy cost of activity i.

For each individual, daily EE was the sum of energy expenditures of all activities in leisure time.[25] It was expressed as total kilocalories expended per kilogram of body weight per day: kcal/kg/day or KKD. An EE of 1.5 to 2.9 KKD was considered *medium* energy expenditure. An EE of 3 or more KKD was *high*; an EE of less than 1.5 KKD, *low*.[24]

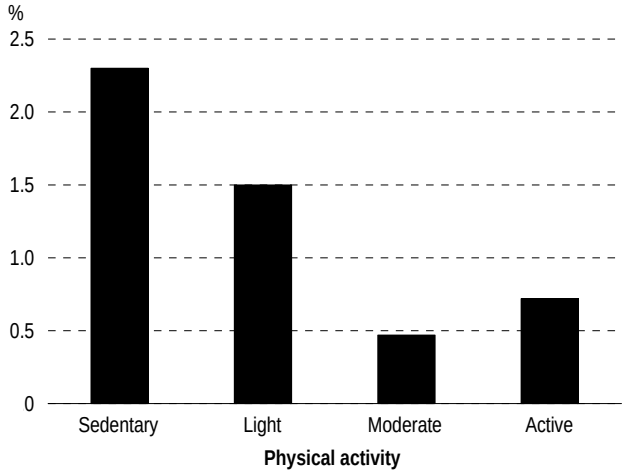
The *frequency* (or regularity) of physical activity was based on the number of times in the previous three months that respondents had participated in a physical activity that lasted more than 15 minutes: *regular* (12 or more times per month) or irregular (11 or fewer times per month).

To examine the effects of *level* and *frequency* of physical activity on health, four physical activity categories were defined:

- *Active*—high (3 or more KKD) energy expenditure during regular physical activity.
- *Moderate*—medium (1.5 to 2.9 KKD) energy expenditure during regular physical activity.
- *Light*—low (less than 1.5 KKD) energy expenditure during regular physical activity.
- *Sedentary*—irregular physical activity regardless of energy expenditure.

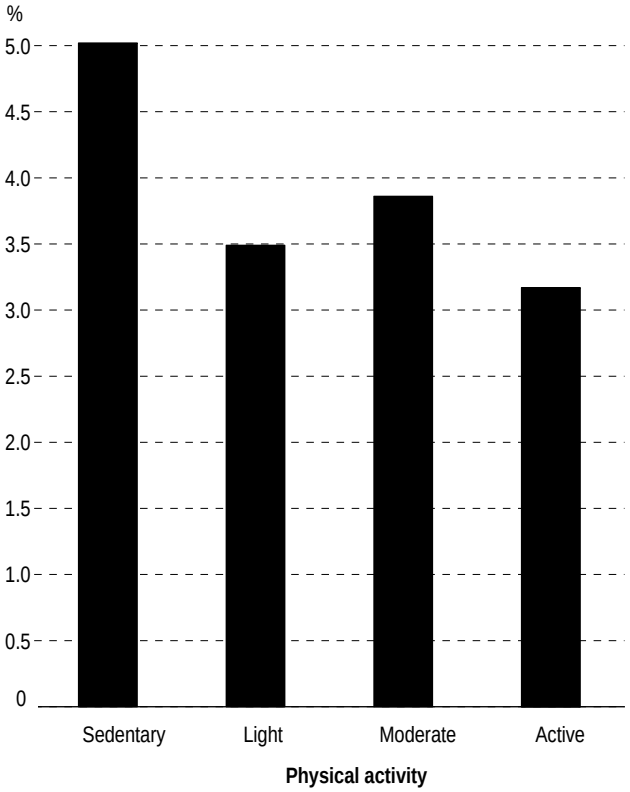
This analysis focuses on the health differences between individuals who regularly engaged in physical activities with high or medium energy expenditure (active and moderate) and those who were less active (light and sedentary).

Chart 1
Age-adjusted two-year incidence of heart disease by leisure-time physical activity, household population aged 20 or older, Canada excluding territories, 1994/95 to 1996/97



Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*

Chart 2
Age-adjusted two-year incidence of depression by leisure-time physical activity, household population aged 12 or older, Canada excluding territories, 1994/95 to 1996/97



Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*

also slightly higher for those in the active group than the moderate group, but the difference was not statistically significant. This implies that regular—and at least moderate—physical activity can be beneficial to heart health. The results also suggest that engaging in physical activity on a more regular basis, even at moderate levels of energy expenditure, may provide some protection against heart disease. Besides the amount of physical activity, being 65 or older was associated with higher odds for heart disease compared with being 20 to 44.

Table 1
Adjusted odds ratios for two-year incidence of heart disease, household population aged 20 or older who were healthy and free of heart disease in 1994/95, by selected characteristics, Canada excluding territories, 1994/95 to 1996/97

Characteristics in 1994/95	Odds ratio	95% confidence interval
Leisure-time physical activity		
Active	1.3	0.41, 3.89
Moderate†	1.0	...
Light	3.7*	1.26,10.67
Sedentary	5.0*	1.84,13.59
Age group		
20-44†	1.0	...
45-64	2.1	0.72, 6.11
65+	12.6*	5.08,31.44
Sex		
Male†	1.0	...
Female	0.7	0.35, 1.42
Educational attainment		
Less than secondary graduation†	1.0	...
Secondary graduation or more	0.8	0.37, 1.75
Household income		
Low†	1.0	...
Middle	1.4	0.52, 3.71
High	3.2	0.72,14.51
Activity limitation		
Yes	3.1	0.96, 9.91
No†	1.0	...
Smoking status		
Daily	2.1	0.88, 5.10
Occasional/Former	0.9	0.40, 2.01
Never†	1.0	...
High blood pressure		
Yes	0.5	0.13, 1.77
No†	1.0	...
Body mass index (BMI)		
Overweight (BMI >27)	1.7	0.67, 4.48
Not overweight (BMI ≤ 27)†	1.0	...

Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*
† Reference category, for which odds ratio is always 1.0
** $p < 0.05$*
... Not applicable

Incidence of depression

The age-adjusted two-year incidence of depression differed mainly between the three groups who engaged in regular physical activity regardless of level (about 3%) and the group who did not participate regularly (5%) (Chart 2). Because the incidence of depression varied by age, education, household income and activity limitation status (Appendix Table B),[6,11,28,29] it was necessary to control for these risk factors when considering the effects of physical activity on depression.

After these factors were controlled, those who were sedentary during leisure time had higher odds of experiencing a depressive episode than did their counterparts who engaged in moderate activity (Table 2). The differences in the incidence of depression between active and moderate were not statistically significant, however. This suggests that even moderate physical activity performed regularly may be instrumental in preventing or managing depression. As well as physical activity, age and activity limitation were related to depression. Those who were young (12 to 19) or who had an activity limitation had higher odds of having had a depressive episode in the past year.

Table 2
Adjusted odds ratios for two-year incidence of depression, household population aged 12 or older who were healthy and free of depression in 1994/95, by selected characteristics, Canada excluding territories, 1994/95 to 1996/97

Characteristics in 1994/95	Odds ratio	95% confidence interval
Leisure-time physical activity		
Active	1.0	0.60, 1.56
Moderate†	1.0	...
Light	1.1	0.60, 1.77
Sedentary	1.6*	1.03, 2.48
Age group		
12-19†	1.0	...
20-44	0.6*	0.35, 0.87
45-64	0.4*	0.24, 0.61
65+	0.5*	0.29, 0.91
Sex		
Male†	1.0	...
Female	1.3	0.95, 1.82
Education		
Less than secondary graduation†	1.0	...
Secondary graduation or above	0.8	0.56, 1.18
Household income		
Low†	1.0	...
Middle	0.7	0.46, 1.15
High	1.1	0.61, 2.04
Activity limitation		
Yes	2.3*	1.35, 4.04
No†	1.0	...

Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*
† Reference category, for which odds ratio is always 1.0
** $p < 0.05$*
... Not applicable

Moderate activity beneficial

Accumulating evidence indicates that physical activity may have multiple beneficial physiological and metabolic effects on heart health. These include "advantageous effects on atherosclerosis, plasma lipid/lipoprotein profiles, blood pressure, availability of oxygenated blood for heart muscle needs (ischemia), blood clotting (thrombosis), and heart rhythm disturbances (arrhythmia)."[3] Physical activity may also have positive effects on heart disease risk factors, such as obesity, distribution of body fat, and incidence of non-insulin-dependent diabetes, and on the prevalence of smoking.[3,9,12,14]

The effects of physical activity on depression may also be diverse. It has been suggested that "exercise-induced changes in brain neuroreceptor concentrations of monoamines (norepinephrine, dopamine, or serotonin) or endogenous opiates (endorphins and enkephalins) may help to favorably alter mood."[3] In addition, physical activity may provide psychological benefits, such as "having the opportunity for social interaction and support, experiencing increased feelings of self-mastery and self-efficacy, and experiencing relief from daily stressors."[3]

Although active and moderate participation in physical activity may have protective effects against heart disease or depression in general, vigorous physical activity may carry some risks, such as musculoskeletal injuries or sudden acute cardiac events. Those who engage in moderate physical activity, however, may be at lower risk of injury compared with those who engage in vigorous activity. While it is recommended that persons with heart conditions and seniors with multiple cardiovascular risk factors should have a medical

consultation before beginning vigorous activity,[3,30,31] moderate participation appears to safely produce health benefits.

Concluding remarks

This prospective analysis of the incidence of heart disease and depression over the two-year period between the first two cycles (1994/95 and 1996/97) of the National Population Health Survey clarifies the direction of the associations between physical activity and health. It suggests that physical activity has protective effects on heart health and mental health that are independent of many other risk factors. The associations are consistent with previous

Definitions

National Population Health Survey (NPHS) respondents were asked if they had any "long-term conditions that have lasted or are expected to last 6 months or more and that have been diagnosed by a health professional." The interviewer then read a list of conditions. *Heart disease* was included in this list. (If respondents asked what was meant by "heart disease," they were told that it includes angina, heart failure, and rheumatic heart disease.) *High blood pressure*, also relevant to this analysis, was among the conditions listed.

Using the methodology of Kessler et al.,[32] the NPHS identifies a major depressive episode (MDE) with a subset of questions from the Composite International Diagnostic Interview. These questions cover a cluster of symptoms for depressive disorder, which are listed in the *Diagnostic and Statistical Manual of Mental Disorders (DSM III-R)*.[33] Responses to these questions were scored on a scale and transformed into a probability estimate of a diagnosis of MDE. If this estimate was 0.9 (that is, 90% certainty of a positive diagnosis), then the respondent was considered to have experienced *depression* in the previous 12 months.[11]

Educational attainment was collapsed into two categories: less than secondary graduation, and secondary graduation or more.

Household income groups were defined by taking into account both household income and the number of people in the household. Three groups were established:

Income group	Number of household members	Household income
Low	1 or 2	Less than $14,999
	3 or 4	Less than $19,999
	5 or more	Less than $29,999
Middle	1 or 2	$15,000 to $59,999
	3 or 4	$20,000 to $79,999
	5 or more	$30,000 to $79,999
High	1 or 2	$60,000 and over
	3 or 4	$80,000 and over
	5 or more	$80,000 and over

A positive response to the question, "Because of a long-term physical or mental condition or a health problem, are you limited in the amount of physical activity you can do at home? at school? at work? in other activities, such as transportation to or from work or leisure time activities?" or "Do you have any long-term disabilities or handicaps?" indicated an *activity limitation*.

Smoking status was determined by asking the following questions: (1) "At the present time do you smoke cigarettes daily, occasionally or not at all?" and (2) "Have you ever smoked cigarettes at all?". Those who chose "daily" in response to Question 1 were classed as *daily* smokers; those replying, "occasionally," as *occasional* smokers. *Former* smokers are those who chose "not at all" in answer to Question 1 and "yes" for Question 2. Respondents who answered "no" to Question 2 were given *never* smoking status.

Body mass index (BMI), which was calculated by dividing weight in kilograms by height in metres squared, was grouped into two categories: overweight (a BMI of more than 27) and not overweight (a BMI of 27 or less).[34] Some caution is warranted in using BMI in populations containing individuals older than 64. The BMI may be less reliable because of loss of height as persons age.[35,36]

Limitations

National Population Health Survey (NPHS) data are subject to the problems inherent in self-reporting. There was no independent source to confirm whether people who reported having been diagnosed with heart disease or other health problems were actually afflicted.

Ideally, a study of the incidence of heart disease should control for other potential confounding risk factors, such as diet and cholesterol, but this information was not collected by the NPHS.[3,4,37-39] A study of the incidence of heart disease should also control for diabetes.[3,6,25,28] However, the sample size for respondents with diabetes who described their health as excellent or very good in 1994/95 was too small to produce reliable estimates of the incidence of heart disease among them by 1996/97.

As well, the analysis of depression should exclude people who had suffered recurrent or chronic depression before the first NPHS cycle,[20] but such information is not available.

A longer period would be preferable to examine the temporal relationship between change in physical activity and the incidence of heart disease or depression.[5,6] This will be possible only when new cycles of longitudinal data become available.

A measure of total energy expenditure rather than only that pertaining to leisure time would be more useful, as some individuals may expend considerable amounts of energy in their non-leisure time (at work or doing household chores, for example).[40] A direct assessment of physical fitness would also have higher accuracy and reliability in measuring physical activity than self-reported information. It has been suggested that potential measurement errors would tend to reduce the strength of the association between physical activity and health.[3,40]

studies, and they show a temporal sequence; that is, physical activity status preceded the onset of heart disease or depression.[3,9,12,14] Nonetheless, causality has not been established. Both heart disease and depression have complex origins and usually develop over a long period. A two-year follow-up study may remain subject to some undetected selection bias. And because a respondent's past level and duration of physical activity are unknown, the effect of physical activity on health can also be subject to error.

Even so, the results indicate that regular and at least moderate physical activity is associated with reduced odds of heart disease and depression. They also underscore the importance of encouraging more people to make moderate physical activity a part of their lives.[2,14,17]

Despite many years of health promotion, about 4 in 10 Canadian adults are sedentary during their leisure time. Some research suggests that among such persons, the previous emphasis on vigorous exercise may have been seen as unrealistic.[2,3,12,32] Consequently, many inactive persons may have been discouraged from pursuing physical activity. The results of this analysis, however, can be added to those showing that moderate, but regular, physical activity confers health benefits. ●

References

1 Statistics Canada. *National Population Health Survey Overview, 1996/97* (Catalogue 82-567) Ottawa: Minister of Industry, 1998.

2 Health Canada and Canadian Society for Exercise Physiology. *Handbook for Canada's Physical Activity Guide to Healthy Active Living* (Catalogue H39-429-1998-2E) Ottawa: Health Canada, 1998.

3 U.S. Department of Health and Human Services. *Physical Activity and Health: A Report of the Surgeon General* (Catalogue S/N 017-023-00196-5) Pittsburgh, Pennsylvania: Superintendent of Documents, 1996: 1-278.

4 Berlin JA, Colditz GA. A meta-analysis of physical activity in the prevention of coronary heart disease. *American Journal of Epidemiology* 1990; 132(4): 612-28.

5 Blair SN. Physical activity, fitness and coronary heart disease. In: Bouchard C, Shephard RJ, Stephens T, et al., eds. *Physical activity, fitness and health: International proceedings and consensus statement*. Champaign, Illinois: Human Kinetics Publishers, 1994: 579-89.

6 Camacho TC, Roberts RE, Lazarus NB, et al. Physical activity and depression: Evidence from the Alameda County Study. *American Journal of Epidemiology* 1991; 134(2): 220-31.

7 LaPorte RE, Adams LL, Savage DD, et al. Review and commentary: The spectrum of physical activity, cardiovascular disease and health: An epidemiological perspective. *American Journal of Epidemiology* 1984; 120(4): 507-17.

8 Morgan W. Physical activity, fitness and depression. In: Bouchard C, Shepherd RJ, Stephens T, et al., eds. *Physical activity, fitness and health*. Champaign, Illinois: Human Kinetics Publishers, 1994: 851-81.

9 Powell KE, Thompson PD, Caspersen CJ, et al. Physical activity and the incidence of coronary heart disease. *Annual Review of Public Health* 1987; 8: 253-87.

10 Heart and Stroke Foundation of Canada. *Heart disease and stroke in Canada*. Ottawa: Heart and Stroke Foundation of Canada, 1997.

11 Beaudet MP. Depression. *Health Reports* (Statistics Canada, Catalogue 82-003) 1996; 7(4): 11-24.

12 Blair SN, Kohl HW, Gordon NF, et al. How much physical activity is good for health? *Annual Review of Public Health* 1992; 13: 99-126.

13 Duncan JJ, Gordon NF, Scott CB. Women walking for health and fitness. How much is enough? *Journal of the American Medical Association* 1991; 266(23): 3295-9.

14 Pate RR, Pratt M, Blair SN, et al. Physical activity and public health: A recommendation from the Centers for Disease Control and Prevention and the American College of Sports Medicine. *Journal of the American Medical Association* 1995; 273(5): 402-7.

15 Rippe JM, Ward A, Porcari JP, et al. Walking for health and fitness. *Journal of the American Medical Association* 1988; 259(18): 2720-4.

16 Pratt M. Benefits of lifestyle activity vs structured exercise (editorials). *Journal of the American Medical Association* 1999; 281(4): 375-6.

17 Dunn AL, Marcus BH, Kampert JB, et al. Comparison of lifestyle and structured interventions to increase physical activity and cardiorespiratory fitness: A randomized trial. *Journal of the American Medical Association* 1999; 281(4): 327-34.

18 Tambay J-L, Catlin G. Sample design of the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(1): 29-38.

19 Swain L, Catlin G, Beaudet MP. The National Population Health Survey—its longitudinal nature. *Health Reports* (Statistics Canada, Catalogue 82-003) 1999; 10(4): 69-82.

20 Glass RM. Treating depression as a recurrent or chronic disease. *Journal of the American Medical Association* 1999; 281(1): 83-4.

21 Yung W. Variance estimation for public use microdata files. *Symposium on new directions in surveys and census.* Ottawa: Statistics Canada, 1997.

22 Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1992; 18(2): 209-17.

23 Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research*, 1996; 5: 283-310.

24 Statistics Canada. Appendix F: Derived variables in *National Population Health Survey, 1994/95 Public use microdata files* (Catalogue 82F0001XCB). Ottawa: Minister of Industry, 1995: 17-20.

25 Stephens T, Craig CL, Ferris BF: Adult physical activity in Canada: Findings from the Canada Fitness Survey I. *Canadian Journal of Public Health* 1986; 77(4): 285-90.

26 Nieto FJ. Cardiovascular disease and risk factor epidemiology: a look back at the epidemic of the 20th century. *American Journal of Public Health* 1999; 89(3): 292-3.

27 Canadian Heart Health Surveys Research Group. Obesity: a risk factor for cardiovascular disease. *Canadian Medical Association Journal* 1997; 157 (Supplement).

28 Farmer ME, Locke BZ, Moscicki EK, et al. Physical activity and depressive symptoms: The NHANES UTLI epidemiologic follow-up study. *American Journal of Epidemiology* 1988; 128(6): 1340-51.

29 Stephens T. Physical activity and mental health in the United States and Canada: evidence from four population surveys. *Preventive Medicine* 1988; 17: 35-47.

30 NIH Consensus Development Panel on Physical Activity and Cardiovascular Health. Physical activity and cardiovascular health. *Journal of the American Medical Association* 1996; 276(3): 241-6.

31 Wannamethee SG, Shaper AG, Walker M. Changes in physical activity, mortality, and incidence of coronary heart disease in older men. *Lancet* 1998; 351(9116): 1603-8.

32 Kessler RC, McGonagle KA, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States: Results from the National Comorbidity Survey. *Archives of General Psychiatry* 1994; 51(1): 8-19.

33 American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders*. Revised, 3rd rev. ed. Washington, D.C.: American Psychiatric Association, 1987.

34 Health and Welfare Canada, Expert Group convened by Health Promotion Directorate, Health Services and Promotion Branch. *Canadian Guidelines for Healthy Weights.* Ottawa: Health and Welfare Canada, 1988.

35 WHO Expert Committee. *Physical Status: The Use of and Interpretation of Anthropometry* (WHO Technical Report Series, No. 854) Geneva: World Health Organization, 1997.

36 Boström G, Diderichsen F. Socioeconomic differentials in misclassification of height, weight and body mass index based on questionnaire data. *International Journal of Epidemiology*, 1997; 26(4): 860-6.

37 Haapanen N, Miilunpalo S, Vuori I, et al. Association of leisure time physical activity with the risk of coronary heart disease, hypertension and diabetes in middle-aged men and women. *International Journal of Epidemiology* 1997; 26(4): 739-47.

38 Leon AS, Connett J, Jacobs DR, et al. Leisure-time physical activity levels and risk of coronary heart disease and death: the multiple risk factor intervention trial. *Journal of the American Medical Association* 1987; 258(17): 2388-95.

39 Simoes EJ, Byers T, Coates RJ, et al. The association between leisure-time physical activity and dietary fat in American adults. *American Journal of Public Health* 1995; 85(2): 240-4.

40 Weller I, Corey P. The impact of excluding non-leisure energy expenditure on the relation between physical activity and mortality in women. *Epidemiology* 1998; 9(6) 632-5.

Appendix

Table A
Level and frequency of leisure-time physical activity in 1994/95, Canada excluding territories

Level of activity	Total population		Frequency of activity: Regular (12 or more times per month)		Frequency of activity: Irregular (less than 12 times per month)	
	'000	%	'000	%	'000	%
Household population aged 20 or older†	**11,841**	**100.0**	**6,877**	**100.0**	**4,963**	**100.0**
High	2,255	19.0	2,255	32.8	0	0.0
Medium	2,803	23.7	2,753	40.0	50	1.0
Low	6,782	57.3	1,869	27.2	4,913	99.0
Household population aged 12 or older‡	**13,574**	**100.0**	**8,210**	**100.0**	**5,364**	**100.0**
High	3,031	22.3	3,030	36.9	1	0.0
Medium	3,230	23.8	3,131	38.1	99	1.8
Low	7,314	53.9	2,049	25.0	5,265	98.1

Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*
Note: *Detail may not add to totals because of rounding.*
† Individuals who reported their health as excellent or very good and who were free of heart disease in 1994/95
‡ Individuals who reported their health as excellent or very good and who were free of depression in 1994/95

Table B

Unadjusted two-year incidence of heart disease or depression, household population healthy and free of heart disease or depression in 1994/95, by selected characteristics, Canada excluding territories, 1994/95 to 1996/97

	Heart disease (age 20 or older)			Depression (age 12 or older)		
	Total			Total		
Characteristics in 1994/95	Sample size	Population '000	Two-year incidence %	Sample size	Population '000	Two-year incidence %
Total	7,158	12,456	1.4	7,593	13,578	4.1
Leisure-time physical activity†						
Active	1,309	2,255	0.7	1,622	3,030	3.6
Moderate	1,616	2,753	0.5	1,778	3,131	3.8
Light	1,131	1,869	1.6	1,189	2,049	3.4
Sedentary	2,822	4,963	2.2	3,002	5,364	4.8
Missing	280	616	1.2	2	4	0.0
Age group						
12-19	...	...	...	887	2,061	6.9
20-44	4,386	8,011	0.6	4,021	7,321	3.8
45-64	1,876	3,286	1.8	1,773	3,056	2.8
65+	896	1,159	5.9	912	1,139	4.1
Sex						
Male	3,298	6,314	1.7	3,505	6,858	3.5
Female	3,860	6,142	1.1	4,088	6,720	4.7
Educational attainment						
Less than secondary graduation	1,456	2,173	2.7	2,069	3,662	5.5
Secondary graduation or above	5,693	10,266	1.2	5,515	9,900	3.6
Missing	9	18	0.0	9	16	0.0
Household income						
Low	1,134	1,550	1.3	1,254	1,787	5.2
Middle	4,680	7,953	1.3	4,933	8,589	3.5
High	1,071	2,357	2.2	1,110	2,542	4.9
Missing	273	596	0.8	296	660	4.6
Activity limitation						
Yes	749	1,241	3.7	785	1,292	7.9
No	6,408	11,214	1.2	6,806	12,281	3.7
Missing	1	1	0.0	2	5	0.0
Smoking status						
Daily	1,744	2,846	2.0	...	...	...
Occasional/Former	2,565	4,386	1.3	...	...	...
Never	2,847	5,218	1.2	...	...	...
Missing	2	8	0.0	...	...	...
High blood pressure						
Yes	447	611	2.1	...	...	...
No	6,711	11,846	1.4	...	...	...
Body mass index (BMI)						
Overweight (BMI > 27)	1,949	3,207	2.2	...	...	...
Not overweight (BMI ≤ 27)	5,036	8,965	1.1	...	...	...
Missing	173	284	2.0	...	...	...

Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*

Note: *Detail may not add to totals because of rounding.*

† Because these figures are not age-adjusted, two-year incidence rates differ slightly from those in Charts 1 and 2.

... Not applicable

Body mass index and health

Jason Gilmore

Abstract

Objectives

This article describes the prevalence of the four international body mass index (BMI) categories—underweight (18.5 or less), acceptable weight (18.6 to 24.9), overweight (25 to 29.9) and obese (30 or more)—by selected socio-demographic and lifestyle characteristics. It also examines the association between BMI and selected health problems.

Data source

The data are from the household component of the 1996/97 National Population Health Survey, conducted by Statistics Canada. Results are based on a sample of 50,347 respondents aged 20 to 64.

Analytical techniques

Prevalence estimates of BMI categories were calculated. Multivariate analyses were used to examine associations between BMI and various health conditions by smoking status, while controlling for age and sex.

Main results

In 1996/97, about half of Canadian adults were in the acceptable weight range; 34% were overweight; 12%, obese; and 2%, underweight. Being overweight or obese was associated with asthma, arthritis, back problems, high blood pressure, diabetes and thyroid disorders, although this varied with smoking status. Underweight smokers had high odds of reporting cancer, bowel disorders, ulcers, and migraine.

Key words

body weight, obesity, thinness, risk factors, smoking

Author

Jason Gilmore (613-951-7118; gilmjas@statcan.ca) is with the Health Statistics Division at Statistics Canada, Ottawa K1A 0T6.

The relationship between weight and health is widely acknowledged. The association of excess weight with health problems such as heart disease, Type II diabetes, high blood pressure and stroke has been extensively documented.[1-6] But being too thin can also endanger health. Thus, other research has investigated the prevalence of underweight, usually among women, and its association with eating disorders.[7] Few studies have compared the health of those who are underweight and those who are overweight with individuals of "acceptable" weight. However, data from the National Population Health Survey (NPHS), which are not available from other surveys, allow such a comparison.

The body mass index (BMI), which relates weight to height, is the most common method of determining if an individual's weight is in a healthy range (see *Body mass index).* This analysis, based on the 1996/97 NPHS (see *Methods*, *Definitions* and *Limitations),* describes the socio-demographic characteristics and lifestyle behaviours of adult Canadians (aged 20 to 64) in the context of internationally accepted BMI groupings. It also explores the relationship between

various health conditions and the three unacceptable BMI categories: underweight, overweight and obese. Because smoking is related to body weight and is also a risk factor for many medical problems,[8] the effect of smoking status is assessed as well. While most studies relating BMI to health have focussed on particular diseases, this article examines a broader set of health indicators: thirteen chronic conditions, along with activity restriction, repetitive strain injuries, depression, and self-rated health status.

Methods

Data source

This article is based on Statistics Canada's National Population Health Survey (NPHS). The NPHS, which began in 1994/95, collects information about the health of the Canadian population every two years.[9,10] It covers household residents in all provinces and territories, except people living on Indian reserves, on Canadian Forces bases, and in some remote areas. The NPHS has both a longitudinal and a cross-sectional component. Respondents who are part of the longitudinal component will be followed for up to 20 years.

This analysis of Body Mass Index (BMI) uses cross-sectional data from cycle 2 of the NPHS, conducted in 1996/97. The data analyzed pertain to the household population in the 10 provinces.

The 1996/97 cross-sectional sample is made up of longitudinal respondents and respondents who were selected as part of supplemental samples, or buy-ins, in three provinces. The additional respondents for the buy-ins were chosen with the random digit dialing (RDD) technique and were included for cross-sectional purposes only.

Individual data are organized into two files: General and Health. Socio-demographic and some health information was obtained for each member of participating households. These data are found in the General file. Additional in-depth health information was collected for one randomly selected household member. The in-depth health information, as well as the information on the General file pertaining to that individual, is found in the Health file.

In households belonging to the cross-sectional buy-in component, one knowledgeable person provided the socio-demographic and health information about all household members for the General file. As well, one household member, not necessarily the same person, was randomly selected to provide in-depth health information about himself or herself for the Health file.

Among individuals in the longitudinal component, the person providing in-depth health information about himself or herself for the Health file was the randomly selected person for that household in cycle 1 (1994/95) and was usually the person who provided information on all household members for the General file in cycle 2.

In 1996/97, there were 81,804 respondents to the questions on the Health file. The 1996/97 cross-sectional response rates for the Health file were 93.1% for the longitudinal component and 75.8% for the RDD component, yielding an overall response rate of 79.0%.

The target population for this analysis is adults aged 20 to 64. Younger and older people, as well as pregnant women, were excluded because of their changing weight and/or height, which can distort BMI ratings. The cross-sectional file for the calculation of BMI had a sample of 50,347 respondents aged 20 to 64, representing an estimated 17.7 million people.

Analytical techniques

Prevalence estimates of underweight, acceptable weight, overweight and obesity by various characteristics were calculated. Cross-tabulations by educational attainment, household income, birthplace, alcohol consumption, smoking, and leisure-time physical activity were age-adjusted to the 1996/97 Canadian population, both sexes. All estimates were weighted to represent the population at the time of the survey. Tests of significance were done on unadjusted percentages. Critical values were adjusted to take multiple comparisons into account.

BMI ratings are related to a variety of health conditions. Logistic regressions were used to estimate the odds ratios for various conditions among people who were underweight, overweight or obese. Separate regressions were done for smokers, former smokers and never-smokers in each BMI category. Additional independent variables were the age and sex of the respondents. Acceptable weight by smoking status was the reference group for each of these analyses. A separate logistic regression was used to estimate the odds of various health conditions among people who were obese, compared with those who were overweight. Respondents with information missing for one or more variables were omitted from the analysis.

The sample weights were used in all the analyses. A weighted bootstrap resampling procedure was used to calculate coefficients of variations for totals and rates.[11,12] This techinque also served to test the significance of differences between rates and to estimate standard errors used in the calculation of the confidence intervals for the odds ratios. Results at the 0.05 level were considered significant.

One in eight obese

In 1996/97, the weight of almost half (48%) of Canadians aged 20 to 64 was in a range appropriate to their height (Table 1). Another 34% were overweight, and 12%, approximately 2.1 million, were obese. Research indicates that calculations based on self-reported height and weight underestimate obesity by about 10%;[2] therefore, 2.3 million may be a more accurate estimate of the number of obese adults.

According to data compiled by the Organisation for Economic Co-operation and Development, Canada's obesity rate was higher than levels reported

Body mass index

Body mass index (BMI) is calculated by dividing weight in kilograms by height in metres squared. For example, to calculate the BMI of someone 5 feet 8 inches tall weighing 160 pounds, it is first necessary to convert their height into metres (68 inches X 2.54 = 172.7 centimetres or 1.727 metres) and their weight into kilograms (160 pounds X 0.454 = 72.6 kilograms). The BMI of this individual is 24.4, a result of dividing weight (72.6 kilograms) by height in metres squared (1.727 X 1.727 = 2.98).

The BMI categories used for this article are: 18.5 or less (underweight), 18.6 to 24.9 (acceptable weight), 25.0 to 29.9 (overweight), and 30.0 or more (obese). These groupings are endorsed by the World Health Organization[13,14] and the National Institutes of Health[1] of the United States. This classification differs from the Canadian standard: less than 20.0 (underweight), 20.0 to 24.9 (acceptable weight), 25 to 27.0 (some excess weight), and more than 27.0 (overweight).[15] The international standard is used here so that results for Canada can be compared with those of other countries. BMI is calculated for people aged 20 to 64 (excluding pregnant women).

In 1996/97, the average height of Canadian women aged 20 to 64 was 1.63 metres (5 feet 4 inches), and their average weight was 65.8 kilograms (145 pounds). The average man was 1.78 metres tall (5 feet 10 inches) and weighed 83.2 kilograms (183 pounds).[1] Thus, using the formula, the average woman's BMI was 24.8 (acceptable range), and the average man's, 26.3 (overweight).

While height varied little among age groups, weight tended to rise with age. For women, average weight increased from 62.2 kilograms (137 pounds) at ages 20 to 24 to 68.9 kilograms (152 pounds) at ages 55 to 64. For men, average weight was lowest at ages 20 to 24 (79.5 kilograms or 175 pounds), and highest at ages 45 to 54 (84.6 kilograms or 187 pounds).

Table 1
Percentage distribution of body mass index categories, population aged 20 to 64, by selected characteristics, Canada excluding territories, 1996/97

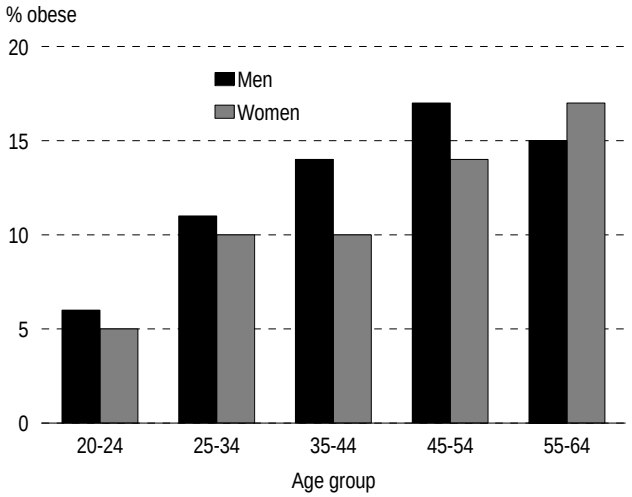
	Population	Under-weight	Acceptable weight	Over-weight	Obese	Not stated
	'000			%		
Total 20-64	**17,702**	**2**	**48**	**34**	**12**	**3**
Age and sex						
Men	8,955	1	40	44	13	1
Women	8,748	4	56	24	11	5
20-24	1,837	5	65	22	6	2
Men	948	2‡	60	31	6	1‡
Women	889	9	69	13	5†	3
25-34	4,319	3	53	31	10	3
Men	2,209	1‡	45	42	11	1‡
Women	2,110	6	60	20	10	4
35-44	5,213	2	49	34	12	3
Men	2,645	- -	39	46	14	1
Women	2,568	3	60	22	10	5
45-54	3,768	1	40	40	15	3
Men	1,922	1‡	31	50	17	2‡
Women	1,846	2†	49	30	14	5
55-64	2,565	1†	38	42	16	3
Men	1,231	1‡	32	49	15	2‡
Women	1,334	2†	43	34	17	5
Education§						
Less than high school	3,179	2	42	37	16	3
High school	3,109	3	47	34	12	4
Some post-secondary	4,459	3	47	35	12	3
Postsecondary graduation	6,849	2	52	33	10	3
Missing	105	- -	39	34	9†	13†
Household income§						
Lowest	733	4†	52	29	14	2†
Lower-middle	1,387	4†	46	31	16	2†
Middle	4,092	3	47	34	14	2
Upper-middle	6,232	2	48	36	12	2
Highest	2,554	2	50	37	9	2
Missing	2,704	3	47	32	10	8
Province						
Newfoundland	336	- -	42	39	17	- -
Prince Edward Island	79	2‡	38	41	16	- -
Nova Scotia	557	- -	42	37	18	- -
New Brunswick	446	- -	38	40	20	- -
Québec	4,465	3	51	33	11	2
Ontario	6,736	3	48	33	12	4
Manitoba	627	2†	43	36	15	4
Saskatchewan	527	- -	39	40	18	- -
Alberta	1,633	2	47	36	12	3
British Columbia	2,295	2‡	52	35	10	1‡
Birthplace§						
Canada	14,165	2	47	35	13	3
United States, Europe, Australia	1,837	2	49	35	11	3
Asia	1,079	7	62	22	5†	3†
Elsewhere	579	2†	46	39	9	4†
Missing	41	- -	- -	- -	- -	- -

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
Note: *Because of rounding, detail may not add to totals.*
† Coefficient of variation between 16.6% and 25.0%
‡ Coefficient of variation between 25.1% and 33.3%
§ Age-adjusted to the 1996/97 Canadian population, both sexes.
- - Amount too small to provide reliable estimate

for the Netherlands (7%), France (8%) and Australia (9%).[16] However, the rate in Canada was well below that in England (16%)[13] and the United States (23%).

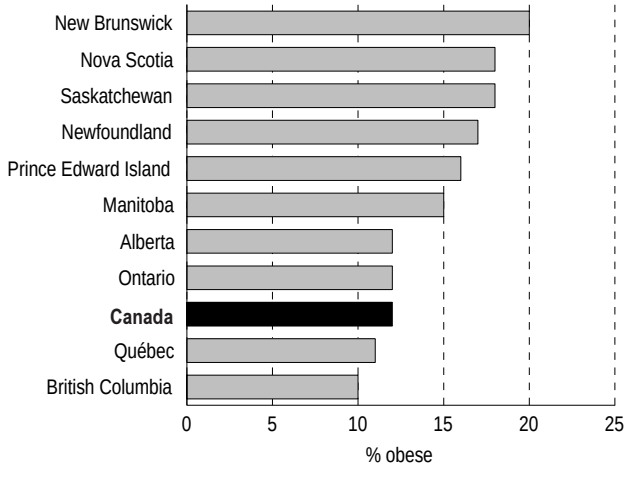
Underweight was relatively uncommon. Only 2% of Canadian adults, about 400,000, were classified as underweight.

Chart 1
Prevalence of obesity,† population aged 20 to 64, by age group and sex, Canada excluding territories, 1996/97



***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
† Body mass index 30+

Chart 2
Prevalence of obesity,† population aged 20 to 64, by province, 1996/97



***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
† Body mass index 30+

BMI differs by sex and age

Women were significantly more likely than men to have an acceptable weight or to be underweight, while the prevalence of overweight and obesity was significantly higher among men. These patterns echo numerous earlier studies,[3,14,17,18] although men's greater muscle and bone mass accounts for some of the difference.

BMI rose with age. Younger people (both men and women aged 20 to 24) had the lowest rates of overweight and obesity and the highest rates of being at an acceptable weight (Table 1 and Chart 1).

Education, income and province

At each successive level of education, the percentage of people with an acceptable BMI tended to increase, while the proportion classified as overweight or obese tended to decline. This is consistent with the literature,[1,2] and may be partly attributable to more educated people being better informed about healthy dietary practices, the benefits of exercise, and the medical hazards of obesity.

Household income was also related to BMI, but the association was less clear. Obesity tended to be more common among people in lower income households. However, the prevalence of overweight tended to rise with income.

Provincial BMI ratings varied, reflecting, at least in part, different lifestyles and dietary practices. Obesity was more prevalent in the Atlantic region, Saskatchewan and Manitoba than in the other provinces (Chart 2).

Strong links with birthplace

Immigrants born in Asia tended to have lower BMIs than did Canadian-born adults or immigrants born in other parts of the world. In fact, 7% of immigrants born in Asia were underweight, compared with 2% of Canadian-born adults. Only 5% of Asian-born immigrants were obese. By contrast, obesity affected 13% of Canadian-born adults. BMI differences between ethnic groups could be due to differences in body build[19] and may also be related to diet during early childhood.

Drinking, smoking and exercise

BMI was associated with lifestyle behaviour, notably, alcohol consumption, smoking and physical activity. More than a third of current drinkers were overweight, compared with just over a quarter of people who had never been drinkers (Table 2). Obesity, however, was more prevalent among former than current drinkers.

The prevalence of overweight and obesity was highest among former smokers. Whereas 37% of former smokers were overweight, the figure was 34% for current smokers and 33% for people who had never smoked. The corresponding rates of obesity were 14%, 11% and 12%.

As might be expected, obesity was related to physical activity. The obesity rate was 13% among people who were not physically active in their leisure time. For those who were moderately active, the rate was 11%; for those who were active, 9%. By contrast, the prevalence of overweight did not vary substantially with physical activity.

Table 2
Percentage distribution of body mass index categories, population aged 20 to 64, by selected lifestyle behaviour characteristics, Canada excluding territories, 1996/97

	Population	Under-weight	Acceptable weight	Over-weight	Obese	Not stated
	'000			%		
Total 20-64	**17,702**	**2**	**48**	**34**	**12**	**3**
Alcohol consumption†						
Current drinker	14,173	2	48	35	12	2
Former drinker	2,016	3	46	32	15	4
Never drinker	1,334	4	49	27	12	7
Missing	179	- -	38	29	4	21
Smoking†						
Current smoker	5,533	3	50	34	11	2
Former smoker	4,996	1‡	45	37	14	3
Never smoker	7,117	2	49	33	12	4
Missing	55	- -	33‡	30‡	9§	26‡
Leisure-time physical activity†						
Active	3,190	2	51	36	9	2
Moderately active	3,941	2	50	35	11	2
Inactive	10,191	3	47	34	13	3
Missing	380	2§	38	33	15	12‡

Data source: *1996/97 National Population Health Survey 1996/97, cross-sectional sample, Health file*
Note: *Because of rounding, detail may not add to totals.*
† Age-adjusted to the 1996/97 Canadian population, both sexes
‡ Coefficient of variation between 16.6% and 25.0%
§ Coefficient of variation between 25.1% and 33.3%
- - Amount too small to provide reliable estimate

Limitations

Since the National Population Health Survey (NPHS) data used in this analysis are cross-sectional, relationships between variables can be described, but causality cannot be inferred. For instance, it is not possible to determine the temporal relationship between BMI and the presence of chronic diseases. Some diseases cause weight loss, while others are associated with weight gain. Cross-sectional data do not indicate whether a given BMI preceded the respondent's chronic condition, or whether the condition was antecedent to a change in weight.

NPHS data are subject to the problems inherent in self-reporting. There was no independent source to confirm whether people who reported having been diagnosed with various chronic conditions or other health problems were actually afflicted. Equally important, there was no independent measurement of height and weight. Many studies have concluded that self-reported data tend to underreport the prevalence of overweight and obesity by approximately 10%.[2,18,20,21]

BMI is useful for a general analysis of weight categories and their relationship to health. However, BMI is more valuable when used in conjunction with a Waist-to-Hip Circumference ratio or a waist circumference measurement,[1] variables that were not collected by the NPHS.

Although BMI is correlated with body fat,[20,22] it is not a perfect measurement. For example, individuals whose BMI is 31 are considered obese, although some may, in fact, be very muscular and lean. Consequently, they may not be as susceptible to health problems that tend to affect people with the same BMI who have a very high level of body fat.

Broad groupings within variables can result in underestimation of the strength of relationships. For instance, a significant relationship between BMI and cancer could be found only among underweight current smokers. In 1996/97 (and in 1994/95[2]), no relationship could be detected between overweight/obesity and cancer, although certain types of cancer (prostate and colon cancer among men; breast, endometrial and ovarian cancer among women) have been associated with excess weight. The lack of a significant association may be due to the generality of the NPHS question. Questions on specific forms of cancer might have yielded significant results. Similarly, the association of BMI with diabetes may be obscured to some degree because the NPHS did not ask whether it was Type I or Type II diabetes, only the latter of which is linked to obesity.[23]

As well, a selection effect may have influenced response rates, in that people with some chronic conditions may have declined to participate in the survey.

Health associated with thinness

Aside from eating disorders such as anorexia nervosa and bulimia, comparatively little attention has been paid to the health of Canadians who are underweight. Although the NPHS did not ask about eating disorders, information is available about a number of other conditions that may be associated with a low BMI (see *Health outcomes*).[15]

With a few exceptions, the health of people who were underweight did not differ substantially from that of people of acceptable weight. The age- and sex-adjusted odds of suffering from asthma were significantly low for people who were underweight, and their odds of reporting ulcers and depression were significantly high (Table 3).

A much different picture emerges when smoking status is taken into account. Of all weight categories, those who were underweight tended to be most sharply divided into current smokers (42%) and never smokers (43%). Just 15% of underweight individuals were former smokers.

Among current smokers, those who were underweight had significantly high odds of reporting migraine, cancer, ulcers, bowel disorders, and activity limitations than those of normal weight. These associations did not hold for former smokers and never smokers: the odds that those who were underweight would report these conditions were not significantly different from the odds for their counterparts whose weight was in the acceptable range.

The medical problems of underweight current smokers were further reflected in their self-rated health: their odds of assessing their health positively were just a third of those for smokers whose weight was acceptable. Former smokers who were

Table 3
Age- and sex-adjusted odds ratios for selected health characteristics, underweight population aged 20 to 64, by smoking status, Canada excluding territories, 1996/97

	Total†		Current smokers‡		Former smokers§		Never smokers††	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Chronic conditions								
Asthma	0.66*	0.48, 0.91	0.76	0.47, 1.23	0.67	0.23, 2.00	0.56*	0.35, 0.92
Arthritis	1.01	0.64, 1.61	1.26	0.63, 2.49	0.80	0.37, 1.73	0.65	0.26, 1.61
Back problems	0.86	0.59, 1.23	0.98	0.59, 1.63	0.57	0.32, 1.03	0.69	0.33, 1.43
High blood pressure	0.83	0.40, 1.74	0.78	0.23, 2.66	- -	- -	- -	- -
Migraine	1.21	0.86, 1.70	1.59*	1.00, 2.51	1.81	0.65, 5.05	0.68	0.45, 1.03
Diabetes	1.27	0.24, 6.67	- -	- -	- -	- -	- -	- -
Heart disease	0.59	0.32, 1.07	0.50	0.19, 1.32	- -	- -	- -	- -
Cancer	1.74	0.70, 4.31	3.29*	1.17, 9.29	- -	- -	- -	- -
Ulcers	2.11*	1.25, 3.59	2.24*	1.09, 4.61	1.45	0.50, 4.22	1.49	0.62, 3.62
Stroke	1.75	0.64, 4.77	- -	- -	- -	- -	- -	- -
Urinary incontinence	1.29	0.52, 3.24	1.96	0.45, 8.49	- -	- -	1.12	0.30, 4.12
Bowel disorders	1.96	0.97, 3.95	2.81*	1.14, 6.94	0.71	0.25, 1.97	0.99	0.41, 2.38
Thyroid disorders	0.75	0.34, 1.62	0.87	0.15, 4.93	1.34	0.40, 4.43	0.41	0.14, 1.19
Other physical conditions								
Activity limitations	1.12	0.82, 1.53	1.62*	1.05, 2.49	0.54	0.28, 1.04	0.47*	0.32, 0.70
Repetitive strain injuries	0.76	0.51, 1.12	0.85	0.49, 1.47	1.05	0.41, 2.68	0.53	0.27, 1.03
Depression‡‡	1.76*	1.00, 3.09	1.93	0.84, 4.45	1.84	0.73, 4.64	0.99	0.48, 2.06
Self-rated health§§	0.37*	0.24, 0.58	0.31*	0.17, 0.56	0.39*	0.20, 0.76	0.94	0.56, 1.59

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
Note: *Because of rounding, some confidence intervals with 1.00 as the lower limit were significant.*
† Reference category is population aged 20 to 64 of acceptable weight.
‡ Reference category is current smokers aged 20 to 64 of acceptable weight.
§ Reference category is former smokers aged 20 to 64 of acceptable weight.
††Reference category is never smokers aged 20 to 64 of acceptable weight.
‡‡ Re-coded as 1(0.9 probability of major depressive episode in past year) and 0 (0 to 0.8 probability of major depressive episode in past year)
§§ Re-coded as 1 (good, very good, excellent) and 0 (fair, poor)
** p < 0.05*
- - Amount too small to provide reliable estimate

underweight also had low odds of rating their health favourably, but this was not the case for underweight people who had never smoked.

Any examination of the health of underweight Canadians is confounded by the composition of this group. The underweight are likely a combination of healthy people who have always been thin, and people who have lost weight as a result of illness. Because the NPHS data used for this analysis are cross-sectional, neither causality, nor even a temporal sequence, can be determined. It is, in fact, plausible that the underlying cause of low BMI may be diseases such as cancer and ulcers.

The high odds of depression among underweight people overall did not hold for any group when smoking was taken into account. This may reflect the small number of respondents in these categories rather than a lack of association with depression.

High risks for overweight

Much BMI research has been devoted to the health of overweight and obese people. An earlier study, in fact, used the 1994/95 NPHS for this purpose.[2]

This analysis of 1996/97 data shows that after age and sex were controlled, the odds that overweight individuals would have asthma, arthritis, back problems, high blood pressure, diabetes,[5] thyroid problems, activity limitations, and repetitive strain injuries were significantly high, compared with those whose weight was acceptable (Table 4). For example, the odds that overweight individuals would have high blood pressure were 1.86 times higher than those for acceptable-weight people; their odds of diabetes were 1.73 times higher.

However, the health of overweight people varied substantially with their smoking status. Among people who were overweight, the percentages of current and former smokers were almost equal: 30% and 32%, respectively. The largest group, 38%, had never smoked.

Overweight current smokers had significantly higher odds of reporting only two of these health problems—high blood pressure and repetitive strain injuries—than did current smokers of normal weight. Overweight former smokers had high odds of arthritis, high blood pressure, activity limitations, and depression.

Among overweight people who had never smoked, the association between weight and health is evident without the confounding influence of smoking. Compared with never smokers of acceptable weight, those who were overweight had

Health outcomes

Respondents to the National Population Health Survey (NPHS) were asked whether they had "long-term conditions that have lasted or are expected to last 6 months or more and that have been diagnosed by a health professional." The interviewer read a list of conditions. The *chronic conditions* selected for this analysis are: asthma, arthritis, back problems, high blood pressure, migraine, diabetes, heart disease, cancer, ulcers, stroke, urinary incontinence, bowel disorders and thyroid disorders.

Activity limitation refers to a derived variable that is based on a positive response to either of the following questions: "Because of a long-term physical or mental condition or a health problem, are you limited in the kind or amount of activity you can do ... 1) at home, 2) at school, 3) at work, 4) in other activities?" or "Do you have any long-term disabilities or handicaps?"

Repetitive strain injuries are injuries caused by repetitive strain in the past 12 months that were serious enough to have limited respondents' normal activities.

Using the methodology of Kessler et al.,[24] the NPHS identifies a major depressive episode (MDE) with a subset of questions from the Composite International Diagnostic Interview. These questions cover a cluster of symptoms for depressive disorder, which are listed in the *Diagnostic and Statistical Manual of Mental Disorders (DSM III-R*).[25] Responses to these questions were scored on a scale and transformed into a probability estimate of a diagnosis of MDE. If this estimate was 0.9 (that is, 90% certainty of a positive diagnosis), then the respondent was considered to have experienced *depression* in the previous 12 months. The variable was re-coded to a dichotomous variable: 1 (serious risk) and 0 (possible or no risk).

General health was assessed with the question: "In general, would you say your health is: excellent, very good, good, fair, poor?" *Self-rated health* was re-coded to a dichotomous variable: 1 (good, very good or excellent) and 0 (fair or poor).

high odds of reporting arthritis, back problems, high blood pressure, diabetes, urinary incontinence, and activity limitations. However, it is possible that some people never smoked because their health was poor to begin with.

Regardless of their smoking status, overweight Canadians viewed their health as relatively good. Their odds of rating their health as good to excellent were not significantly different from those of people whose BMI was in the acceptable range.

Higher risks for obese

Like people who were overweight, those who were obese had high odds of having been diagnosed with asthma, arthritis, back problems, high blood pressure, diabetes, thyroid disorders, activity limitations and repetitive strain injuries (Table 5). In addition, their odds of having heart disease and urinary incontinence were significantly high, compared with people of acceptable weight.

As was true of people in the other BMI categories, the health of those who were obese varied with their smoking status. Of all weight categories, the obese accounted for the smallest percentage of current smokers—just 27%. About a third (34%) were former smokers, and 39% had never smoked.

Whereas overweight current smokers tended to report relatively few health problems, this was not the situation of current smokers who were obese. Compared with current smokers of acceptable weight, those who were obese had significantly high odds of reporting asthma, arthritis, high blood pressure, diabetes and urinary incontinence.

Among those who were obese, being a former smoker was associated with a somewhat different set of health problems: arthritis, back problems, high

Table 4
Age- and sex-adjusted odds ratios for selected health characteristics, overweight population aged 20 to 64, by smoking status, Canada excluding territories, 1996/97

	Total†		Current smokers‡		Former smokers§		Never smokers††	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Chronic conditions								
Asthma	1.21*	1.01, 1.45	1.17	0.88, 1.57	1.17	0.77, 1.78	1.26	0.97, 1.63
Arthritis	1.30*	1.14, 1.49	1.00	0.80, 1.26	1.35*	1.09, 1.67	1.67*	1.30, 2.15
Back problems	1.13*	1.01, 1.26	1.00	0.82, 1.22	1.19	0.97, 1.45	1.27*	1.05, 1.54
High blood pressure	1.86*	1.56, 2.22	1.45*	1.06, 1.99	2.01*	1.49, 2.71	2.06*	1.51, 2.79
Migraine	1.05	0.88, 1.26	0.94	0.67, 1.31	1.18	0.84, 1.65	1.11	0.85, 1.46
Diabetes	1.73*	1.22, 2.45	2.13	0.97, 4.69	- -	- -	1.76*	1.05, 2.95
Heart disease	1.08	0.82, 1.41	0.95	0.58, 1.57	- -	- -	1.04	0.59, 1.81
Cancer	1.13	0.82, 1.55	1.57	0.89, 2.77	- -	- -	- -	- -
Ulcers	0.99	0.77, 1.26	0.93	0.63, 1.38	0.94	0.55, 1.62	1.22	0.80, 1.87
Stroke	1.44	0.81, 2.58	- -	- -	- -	- -	- -	- -
Urinary incontinence	1.04	0.74, 1.48	1.29	0.71, 2.34	0.46*	0.26, 0.79	1.83*	1.06, 3.16
Bowel disorders	0.71*	0.52, 0.98	0.73	0.43, 1.22	0.70	0.39, 1.25	0.70	0.44, 1.11
Thyroid disorders	1.39*	1.08, 1.78	1.52	0.96, 2.42	1.44	0.94, 2.20	1.26	0.86, 1.84
Other physical conditions								
Activity limitations	1.14*	1.01, 1.29	0.96	0.78, 1.19	1.27*	1.01, 1.59	1.31*	1.06, 1.62
Repetitive strain injuries	1.22*	1.08, 1.39	1.42*	1.13, 1.78	1.18	0.92, 1.51	1.05	0.82, 1.33
Depression‡‡	1.07	0.88, 1.30	0.98	0.70, 1.36	1.81*	1.21, 2.72	0.97	0.68, 1.38
Self-rated health§§	0.86	0.73, 1.00	0.84	0.65, 1.07	0.92	0.68, 1.24	0.77	0.56, 1.04

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
† Reference category is population aged 20 to 64 of acceptable weight.
‡ Reference category is current smokers aged 20 to 64 of acceptable weight.
§ Reference category is former smokers aged 20 to 64 of acceptable weight.
††Reference category is never smokers aged 20 to 64 of acceptable weight.
‡‡ Re-coded as 1(0.9 probability of major depressive episode in past year) and 0 (0 to 0.8 probability of major depressive episode in past year)
§§ Re-coded as 1 (good, very good, excellent) and 0 (fair, poor)
** p < 0.05*
- - Amount too small to provide reliable estimate

blood pressure, migraine, and activity limitations. And as was the case for people who were overweight, former smokers were the only group among the obese to have significantly high odds of having had a major depressive episode.

For never smokers, the health risks of obesity alone are evident: asthma, arthritis, back problems, high blood pressure, ulcers, bowel disorders, thyroid disorders, activity limitations, and repetitive strain injuries.

Not surprisingly, whatever their smoking status, the odds that obese individuals would rate their health positively were only about half those of people with acceptable weight. (This figure is roughly equal to that in an analysis of the 1994/95 NPHS.[2]) The low assessments of health could be influenced by self-image as well as by actual medical problems. An American study suggested that obese people may rate their health as poor even if they are not really in poor health. A negative self-rating may reflect an awareness of how society views individuals who are obese.[26]

Added risks of obesity

The additional health risks of obesity are evident when the odds of obese adults having various medical problems are compared with the odds for those who were overweight (Table 6). The odds that obese individuals would report diabetes and urinary incontinence were more than twice the odds for those who were overweight. Other research, too, has shown a significant association between higher BMI and the development and recurrence of urinary incontinence.[1-3,27] It can be brought on

Table 5
Age- and sex-adjusted odds ratios for selected health characteristics, obese population aged 20 to 64, by smoking status, Canada excluding territories, 1996/97

	Total†		Current smokers‡		Former smokers§		Never smokers††	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Chronic conditions								
Asthma	1.59*	1.29, 1.96	1.65*	1.20, 2.28	1.52	1.00, 2.31	1.55*	1.16, 2.08
Arthritis	2.01*	1.67, 2.41	1.85*	1.35, 2.54	2.04*	1.53, 2.71	2.23*	1.68, 2.97
Back problems	1.36*	1.16, 1.58	1.20	0.93, 1.55	1.46*	1.13, 1.89	1.48*	1.11, 1.96
High blood pressure	3.26*	2.74, 3.87	2.69*	1.87, 3.87	3.60*	2.64, 4.90	3.27*	2.46, 4.35
Migraine	1.10	0.88, 1.38	0.81	0.57, 1.16	1.54*	1.05, 2.24	1.01	0.71, 1.45
Diabetes	3.97*	2.92, 5.41	3.33*	1.72, 6.47	- -	- -	- -	- -
Heart disease	1.56*	1.20, 2.04	1.75	0.98, 3.12	- -	- -	1.61	0.94, 2.76
Cancer	0.80	0.48, 1.33	0.62	0.28, 1.35	- -	- -	- -	- -
Ulcers	1.36	0.96, 1.92	1.31	0.73, 2.37	1.23	0.68, 2.22	1.82*	1.03, 3.24
Stroke	1.45	0.70, 2.98	- -	- -	- -	- -	- -	- -
Urinary incontinence	2.57*	1.77, 3.72	4.00*	2.13, 7.50	- -	- -	- -	- -
Bowel disorders	1.49	0.99, 2.23	1.35	0.57, 3.21	1.12	0.67, 1.87	2.08*	1.17, 3.68
Thyroid disorders	1.75*	1.33, 2.31	1.38	0.81, 2.35	1.43	0.94, 2.17	2.22*	1.41, 3.51
Other physical conditions								
Activity limitations	1.64*	1.44, 1.86	1.26	1.00, 1.60	1.73*	1.35, 2.21	2.13*	1.69, 2.69
Repetitive strain injuries	1.26*	1.07, 1.50	1.10	0.78, 1.54	1.27	0.93, 1.73	1.35*	1.02, 1.80
Depression‡‡	1.21	0.95, 1.55	0.97	0.67, 1.41	2.10*	1.40, 3.15	1.24	0.75, 2.04
Self-rated health§§	0.51*	0.44, 0.60	0.64*	0.49, 0.83	0.39*	0.29, 0.54	0.45*	0.34, 0.60

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
† Reference category is population aged 20 to 64 of acceptable weight.
‡ Reference category is current smokers aged 20 to 64 of acceptable weight.
§ Reference category is former smokers aged 20 to 64 of acceptable weight.
††Reference category is never smokers aged 20 to 64 of acceptable weight.
‡‡ Re-coded as 1(0.9 probability of major depressive episode in past year) and 0 (0 to 0.8 probability of major depressive episode in past year)
§§ Re-coded as 1 (good, very good, excellent) and 0 (fair, poor)
** p < 0.05*
- - Amount too small to provide reliable estimate

by, among other things, restricted mobility and medications such as diuretics and diet pills,[28] which have a greater likelihood of being used by obese Canadians (data not shown).

Obese adults' odds of having high blood pressure and bowel disorders were close to two times those for people who were overweight. The odds of asthma, arthritis, back problems, heart disease, and activity limitations were all significantly high for obese people. In light of these findings, it is hardly surprising that obese adults had significantly low odds of rating their health positively, compared with overweight individuals.

Once again, smoking makes a difference, although regardless of smoking status, obese individuals had higher odds of reporting activity limitations and lower odds of assessing their health favourably than did their overweight counterparts. Obese current smokers had high odds of asthma, arthritis and high blood pressure, compared with those who were overweight. For former smokers, the odds of arthritis were higher among those who were obese. Never smokers who were obese had elevated odds of high blood pressure, diabetes, urinary incontinence, and thyroid disorders.

Concluding remarks

Admittedly, body mass index is a less-than-perfect measure. Yet even allowing for its shortcomings, the estimate of the number of people whose weight is inappropriate for their height is considerable. In 1996/97, only about half of Canadians aged 20 to 64 were in an "acceptable" weight range. Moreover, millions, even by the relatively lenient international BMI standard, were obese. While underweight was much less common, a substantial number of adults—about 400,000—were affected.

Table 6
Age- and sex-adjusted odds ratios for selected health characteristics among obese population aged 20 to 64 compared with overweight population aged 20 to 64, by smoking status, Canada excluding territories, 1996/97

	Total†		Current smokers‡		Former smokers§		Never smokers††	
	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval	Odds ratio	95% confidence interval
Chronic conditions								
Asthma	1.32*	1.08, 1.61	1.42*	1.01, 1.99	1.32	0.93, 1.86	1.22	0.87, 1.71
Arthritis	1.54*	1.29, 1.82	1.90*	1.42, 2.55	1.51*	1.15, 1.98	1.32	0.99, 1.76
Back problems	1.19*	1.02, 1.39	1.18	0.89, 1.55	1.23	0.95, 1.58	1.18	0.90, 1.54
High blood pressure	1.82*	1.54, 2.15	2.00*	1.44, 2.79	- -	- -	1.65*	1.24, 2.20
Migraine	1.04	0.83, 1.31	0.85	0.60, 1.19	1.26	0.90, 1.77	0.96	0.63, 1.45
Diabetes	2.28*	1.70, 3.04	- -	- -	- -	- -	1.98*	1.21, 3.23
Heart disease	1.47*	1.10, 1.96	- -	- -	- -	- -	- -	- -
Cancer	0.72	0.44, 1.17	- -	- -	- -	- -	- -	- -
Ulcers	1.34	0.99, 1.82	1.38	0.79, 2.43	1.29	0.76, 2.19	1.44	0.85, 2.42
Stroke	1.06	0.46, 2.45	- -	- -	- -	- -	- -	- -
Urinary incontinence	2.71*	1.81, 4.04	- -	- -	- -	- -	2.07*	1.11, 3.84
Bowel disorders	1.93*	1.31, 2.85	1.81	0.81, 4.04	- -	- -	- -	- -
Thyroid disorders	1.24	0.93, 1.66	- -	- -	- -	- -	1.65*	1.07, 2.56
Other physical conditions								
Activity limitations	1.41*	1.23, 1.62	1.31*	1.01, 1.71	1.37*	1.08, 1.73	1.58*	1.23, 2.02
Repetitive strain injuries	1.02	0.86, 1.21	0.78	0.53, 1.14	1.07	0.80, 1.43	1.28	0.98, 1.67
Depression‡‡	1.12	0.88, 1.43	0.96	0.66, 1.39	1.28	0.83, 1.96	1.21	0.70, 2.07
Self-rated health§§	0.60*	0.51, 0.71	0.77*	0.60, 0.98	0.44*	0.33, 0.57	0.59*	0.44, 0.80

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
† Reference category is overweight population aged 20 to 64.
‡ Reference category is overweight current smokers aged 20 to 64.
§ Reference category is overweight former smokers aged 20 to 64.
†† Reference category is overweight never smokers aged 20 to 64.
‡‡ Re-coded as 1(0.9 probability of major depressive episode in past year) and 0 (0 to 0.8 probability of major depressive episode in past year)
§§Re-coded as 1 (good, very good, excellent) and 0 (fair, poor)
** p < 0.05*
- - Amount too small to provide reliable estimate

The health characteristics of the population aged 20 to 64 depended, to some extent, on whether they were smokers. However, when the influence of smoking was isolated, the associations between BMI and health emerged. Underweight people who had never smoked tended to be in good health. This was not the case for those who were overweight or obese.

The analysis of NPHS data indicates the importance of literally "balancing the scale." Being overweight was associated with several potentially serious medical conditions. Among those who were obese, the number of related health problems was greater, and the associations stronger.

Moreover, the health consequences of obesity are not confined to the individuals affected. For example, a recent Canadian study[29] estimated that the direct cost of obesity (BMI 27+) as it related to hypertension was about $657 million in 1997. The same study put the cost of obesity-related Type II diabetes at $432 million.

Nonetheless, the cross-sectional nature of the data used in this analysis limits the conclusions that can be drawn. While strong associations between BMI

Definitions

To determine *height,* National Population Health Survey (NPHS) respondents were asked how tall they were without shoes. To determine *weight*, they were asked how much they weighed. Women aged 15 to 49 were asked if they were pregnant. If they replied affirmatively, their responses were excluded from the calculations of body mass index.

Respondents were grouped into four *educational attainment* categories: less than high school, high school completion, some postsecondary, and postsecondary graduation. Education was age-standardized to account for the tendency of younger age groups to have higher levels of education than older people.

Household income was divided into five groups based on household size. Income was age-standardized.

Income group	Number of household members	Household income
Lowest	1 to 4	Less than $10,000
	5 or more	Less than $15,000
Lower-middle	1 or 2	$10,000 to $14,999
	3 or 4	$10,000 to $19,999
	5 or more	$15,000 to $29,999
Middle	1 or 2	$15,999 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

To determine *birthplace*, respondents were asked: "In what country were you born?" Answers were grouped into four categories: Canada; the United States, Europe or Australia; Asia; and elsewhere.

The NPHS defined a drink as: one bottle or can of beer or a glass of draft; one glass of wine or a wine cooler; or one drink or cocktail with 1 ½ ounces of liquor. Respondents were asked how often they drank alcoholic beverages in the last 12 months. For this analysis, responses were classfied into three categories: current drinkers, former drinkers and never drinkers. *Current drinkers* comprised regular drinkers (at least one drink per month) and occasional drinkers (less than one drink per month). *Former drinkers* had consumed alcohol in the past but had not done so for at least 12 months. *Never drinkers* were abstainers who had never consumed alcohol.

Respondents were asked if, at the time of the interview, they smoked cigarettes daily, occasionally, or not at all. Those who indicated that they did not smoke cigarettes were asked if they had ever done so. The categories used in this analysis are: current smokers, former smokers and never smokers. *Current smokers* included daily and occasional smokers. *Former smokers* were former daily and occasional smokers. *Never smokers* were those who had never smoked cigarettes

To derive *physical activity*, respondents' energy expenditure (EE) was estimated for each activity they engaged in during their leisure time. EE 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 (expressed in kilocalories expended per kilogram of body weight per hour of activity). To calculate an 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. Respondents whose estimated leisure-time EE was below 1.5 kcal/kg/day were considered physically inactive. A value between 1.5 and 2.9 kcal/kg/day indicated moderate physical activity. Respondents with an estimated EE of 3.0 or more kcal/kg/day were considered physically active. This measure likely underestimated total physical activity, as it did not account for activity at work or while doing household chores.

and various chronic conditions have been demonstrated, it is not possible to determine whether an individual's BMI contributed to the development of a chronic condition or resulted from it.

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References

1 Expert Panel of the National Institutes of Health. Clinical guidelines on the identification, evaluation and treatment of overweight and obesity in adults: Executive Summary. *American Journal of Clinical Nutrition* 1998; 68(4): 899-917.

2 Cairney J, Wade TJ. Correlates of body weight in the 1994 National Population Health Survey. *International Journal of Obesity* 1998; 22: 584-91.

3 Rabkin SW, Chen Y, Leiter L, et al. Risk factor correlates of body mass index. *Canadian Medical Association Journal* 1997; 157(Supplement): s26-s31.

4 Rottensten K. Monograph Series on Aging-related Diseases: IX. Osteoarthritis. *Chronic Diseases in Canada* 1996; 17(3/4): 99-116.

5 Heart and Stroke Foundation, Health Canada, Statistics Canada and University of Saskatchewan. *Heart Disease and Stroke in Canada, 1995*. Ottawa: Heart and Stroke Foundation, 1995.

6 Pi-Sunyer FX. Health implications of obesity. *American Journal of Clinical Nutrition* 1991; 53: 1595S-630S.

7 Health Canada. *The Nature and Dimension of Nutrition and Diet-Related Problems.* Country Paper Canada Supplement. Ottawa: Health Canada, 1994.

8 Manson JE, Stampfer MJ, Hennekens CH, et al. Body weight and longevity: A reassessment. *Journal of the American Medical Association* 1987; 257(3): 353-8.

9 Tambay J-L, Catlin G. Sample design of the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(1): 29-38.

10 Swain L, Catlin G, Beaudet MP. The National Population Health Survey—its longitudinal nature. *Health Reports* (Statistics Canada, Catalogue 82-003) 1998; 10(4): 69-82.

11 Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1992; 18: 209-17.

12 Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5: 283-310.

13 United Kingdom Department of Health. *The Health of the Nation: Briefing Pack,* 2nd edition. London: Health of the Nation Publications Unit, United Kingdom Department of Health, 1997.

14 World Health Organization. *Physical Status: The Use and Interpretation of Anthropometry, Report of the WHO Expert Committee* (WHO Technical Report Series, No. 854) Geneva: World Health Organization, 1995.

15 National Health and Welfare. *Canadian Guidelines for Healthy Weights*. Report of an Expert Group convened by Health Promotion Directorate, Health Services and Promotion Branch. Ottawa: Minister of National Health and Welfare, 1988.

16 Organisation for Economic Co-operation and Development, CREDES. *OECD Health Data 98*, Version 2.0. Paris: Organisation for Economic Co-operation and Development, 1998.

17 World Health Organization. *Obesity: Preventing and Managing the Global Epidemic*, Report of a WHO Consultation on Obesity. Geneva: World Health Organization, 1997.

18 Hill A, Roberts J. Body mass index: a comparison between self-reported and measured height and weight. *Journal of Public Health Medicine* 1998; 20(2): 206-10.

19 Deurenberg P, Yap M, van Staveren WA. Body mass index and percent body fat: a meta analysis among different ethnic groups. *International Journal of Obesity and Related Metabolic Disorders* 1998; 22(12): 1164-71.

20 Roberts, RJ. Can self-reported data accurately describe the prevalence of overweight? *Public Health* 1995; 109(4): 275-84.

21 Kuczmarski R, Carroll MD, Flegal KM, et al. Varying Body Mass Index cutoff points to describe overweight prevalence among U.S. adults: NHANES III (1988 to 1994). *Obesity Research* 1997; 5(6): 542-8.

22 Bray GA. An approach to the classification and evaluation of obesity. In: Bjorntorp P, Brodoff BN, eds. *Obesity.* Hagerstown, Maryland: J.B. Lippincott Company, 1992: 294-308.

23 Bray GA. Obesity increases risk for diabetes. *International Journal of Obesity and Related Metabolic Disorders* 1992; 16 (Supplement 4): s13-s17.

24 Kessler RC, McGonagle KA, Zhao S, et al. Lifetime and 12-month prevalence of DSM-III-R psychiatric disorders in the United States. Results from the National Comorbidity Survey. *Archives of General Psychiatry* 1994; 51: 8-19.

25 American Psychiatric Association. *Diagnostic and Statistical Manual of Mental Disorders.* 3rd rev. ed. Washington, D.C.: American Psychiatric Association, 1987.

26 Ferraro K, Yu Y. Body weight and self-ratings of health. *Journal of Health and Social Behavior* 1995; 36: 274-84.

27 Noblett KL, Jensen JK, Ostergard DR. The relationship of body mass index to intra-abdominal pressure as measured by multichannel cystometry. *International Urogynecology Journal and Pelvic Floor Dysfunction* 1997; 8(6): 323-6.

28 Orbis-AHCN. Incontinence: symptom. [HealthAnswers Website]. Available at: http://www.healthanswers.com/database/ami/converted/003142.html. Accessed November 6, 1998.

29 Birmingham CL, Muller JL, Palepu A, et al. The cost of obesity in Canada. *Canadian Medical Association Journal* 1999; 160: 483-8.

Medications and fall-related fractures in the elderly

Kathryn Wilkins

Abstract

Objectives

This article examines associations between the use of selected medications and fall-related fractures in the household population aged 65 or older.

Data source

The analysis was based on cross-sectional data from the household component of the 1996/97 cycle of the National Population Health Survey. Data were from a sample of 13,363 respondents aged 65 or older.

Analytical techniques

Descriptive statistics and multivariate analyses were used to study cross-sectional associations between selected medications used in the previous month and fractures occurring in the previous year. Multiple logistic regression analyses controlled for potentially confounding factors.

Main results

Among elderly individuals who sustained any activity-limiting injury in 1996/97, an estimated 65,000 reported the most serious such injury had been a fall-related fracture. The odds of a fall-related fracture were significantly low among people who were taking diuretics/antihypertensives. Arthritis and urinary incontinence were positively associated with fall-related fractures.

Key words

drugs, falls, risk factors, aged, injury

Author

Kathryn Wilkins (613-951-1769; wilkkat@statcan.ca) is with the Health Statistics Division at Statistics Canada, Ottawa K1A 0T6.

Falls account for two-thirds of the most serious activity-limiting injuries sustained by seniors, and about half such falls involve bone fractures.[1] The consequences of fractures are substantial, not only because of individual distress and debility, but also because of the ensuing need for health care and personal assistance.

As people age, anatomical and physiological changes such as decreasing bone density and muscle mass contribute to frailty and increase susceptibility to fractures. As well as aging-related influences, extrinsic factors affect the risk of falls and fractures. Medications comprise an important category of such factors, partly because of their extensive use at older ages and also because of the increased sensitivity to the chemical effects of drugs that occurs with age.[2,3]

Research findings about the relationship between medications and fracture risk in the elderly are somewhat inconsistent. For example, numerous studies suggest that drugs prescribed for depression or anxiety increase the risk of fracture or fall.[4-8] Other research has revealed no such association.[9] Studies of diuretics, used to reduce fluid retention and high blood pressure, report that some

preparations of these drugs lower the risk of falling or fracture.[10-14] Other studies have failed to find such associations, or have even reported increases in fall-related injury or fracture risk attributable to

Methods

Data source

The data are from the 1996/97 cross-sectional Health file of Statistics Canada's National Population Health Survey (NPHS). The NPHS, which began in 1994/95, has both a longitudinal and a cross-sectional component and collects information related to the health of the Canadian population every two years, for up to 20 years. The NPHS surveys household and institutional residents in all provinces and territories, except persons living on Indian reserves, Canadian Forces bases, and in some remote areas. The data file used for this analysis pertains to the household population in the provinces.

The 1996/97 cross-sectional sample is made up of longitudinal respondents and respondents who were selected as part of supplemental samples, or buy-ins, in three provinces. The additional respondents for the buy-ins were chosen with the random digit dialing (RDD) technique and were included for cross-sectional purposes only.

Individual data are organized into two files: General and Health. Socio-demographic and some health information was obtained for each member of participating households. These data are found in the General file. Additional in-depth health information was collected for one randomly selected household member. The in-depth health information, as well as the information on the General file pertaining to that individual, is found in the Health file.

In households belonging to the cross-sectional buy-in component, one knowledgeable person provided the socio-demographic and health information about all household members for the General file. As well, one household member, not necessarily the same person, was randomly selected to provide in-depth health information about himself or herself for the Health file.

Among individuals in the longitudinal component, the person providing in-depth health information about himself or herself for the Health file was the randomly selected person for that household in cycle 1 (1994/95) and was usually the person who provided information on all household members for the General file in cycle 2.

In 1996/97, there were 81,804 respondents to the questions on the Health file. The 1996/97 cross-sectional response rates for the Health file were 93.1% for the longitudinal component and 75.8% for the RDD component, yielding an overall response rate of 79.0%.

This analysis is based on data from the sample of 13,363 people aged 65 or older (weighted to represent 3.4 million people) who completed the Health file interview in 1996/97. Of this number, 564 reported that an accidental fall had caused the most serious activity-limiting injury they had had during the previous 12 months, and 281 of these people had sustained a fracture (Appendix Tables A and B). Although it would have been preferable to use longitudinal data to study relationships between medications and fractures, the sample size of the longitudinal file was not large enough.

A more detailed description of the NPHS design, sample, and interview procedures can be found in published reports.[15,16]

Analytical techniques

All analyses were based on data weighted to represent the household population aged 65 or older in the 10 provinces. Cross-sectional data from the Health file were used to calculate descriptive statistics. This article focuses on people who reported in 1996/97 that they had sustained at least one injury serious enough to interfere with their usual activities in the 12 months before their NPHS interview, and that the most serious such injury was a fracture due to a fall.

Multiple logistic regression was used to model cross-sectional associations of the reported use of certain medications with a fall-related fracture.

The following medications were examined in relation to injurious falls: antidepressants, diuretics, antihypertensives (medicine for blood pressure), heart medication, sleep medication and tranquilizers. It is recommended that antihypertensives be prescribed in conjunction with other drugs, particularly diuretics.[17] Therefore, because people who report using antihypertensives might also inadvertently include diuretics as a medication used for blood pressure, a variable combining diuretics and antihypertensives was defined. For this variable, a report of using either blood pressure medication or diuretics was considered as use.

Other factors relevant to the risk of accidental falls or fractures that were included in the logistic model were: age, sex, household income, alcohol use, smoking, chronic conditions (arthritis/rheumatism, diabetes, the effects of a stroke, urinary incontinence, impaired vision), and body mass index. Standard errors and coefficients of variation were estimated with the bootstrap technique to account for survey design effects.[18,19]

diuretic use.[4,9,20,21] Similarly contradictory results have been reported for drugs used to treat cardiovascular disorders.[5]

Although most studies of fracture risk in the elderly are based on data from clinical patients or residents of specific communities, some research on fracture risk has been carried out on larger, population-representative samples in the United States and elsewhere.[22,23] In Canada, the largest population-based study of drug-related fracture was in Saskatchewan, where researchers using administrative data found a negative association between diuretic use and hip fracture risk.[13]

Data representative of the population of all provinces of Canada have only recently become available. The National Population Health Survey (NPHS) provides the opportunity to study fall-related fractures in relation to medications and to personal, social, demographic and health characteristics (see *Methods, Limitations* and *Definitions).*

The purpose of this article is to provide a better understanding of the association of selected

Limitations

The cross-sectional nature of the National Population Health Survey (NPHS) data used for this analysis precludes any inference of causality. Cross-sectional data do not reveal the temporal sequence of events occurring in the same reference period. Therefore, it was not possible to determine whether variables that have been reported to be risk factors for fractures were antecedents or consequences of fracture. For example, the use of medications to control pain, low level of physical activity, or impaired mobility could precede a fracture, in which case it would be appropriate to consider their contributions as risk factors. However, cross-sectional associations between fracture and any of these factors might also occur because they *resulted* from a fracture. Consequently, these factors were not included in the regression model.

Some differences in the reference periods of the independent and dependent variables limit the interpretation of the findings. For example, data on drug use pertained only to medications that respondents reported taking in the month before being interviewed, while the reference period for a fracture was the entire year before the interview. Although most of the medications selected for study are prescribed for long-term conditions and thus would be more likely to have been in use throughout the year and prior to the fall, it is nonetheless probable that some respondents were misclassified (regarding medication use) in the analysis. This would weaken the observed associations, relative to their true strength.

The NPHS data on medications used in the month before the interview contained no details about the active ingredients. The lack of such information limits the interpretation of the analysis, especially if previous research has associated particular substances with the risk of falling. Similarly, NPHS questionnaire items grouping medications with different active ingredients (for example, "antidepressants," "medicine for the heart" and "medicine for blood pressure") hinder the interpretation of associations of specific medications with fall-related fractures.

The sample size of the NPHS restricts the scope of the analysis. Some variables previously reported to influence the risk of fracture in the elderly could not be examined because of the small number of cases. These variables included hormone replacement therapy. Small numbers may also partially account for the failure of the analysis to reveal associations between some of the independent variables, such as limited vision and fall-related fracture. Although it would have been preferable to analyze each sex separately, the small sample size necessitated pooling the data.

The use of the body mass index for people over age 65 is not universally recommended because the loss of height at older ages may affect the validity of self-report for that measure.[24] Nonetheless, the measure is used frequently in research focused on body weight of older people, as well as in reports dealing with falls and fall-related injury in relation to body weight.[7,23,25-32] However, many studies reporting BMI are based on actual measures of height and weight, whereas NPHS data are self-reported.

The analysis was restricted to the NPHS household sample. Therefore, the results are not generalizable to the total senior population, 5% of whom reside in long-term care facilities.[33] In addition, the unavailability of information on people who experienced falls that resulted in death or institutionalization before data were collected weakens the strength of the observed associations.

Finally, because NPHS data were self-reported, their degree of validity is not known.

Table 1
Fall-related fractures arising from most serious activity-limiting injury, by fracture site, household population aged 65 or older, Canada excluding territories, 1996/97

Fracture site	Number	Percentage
Total	**64,822†**	**100**
Arms/Hands	21,731†	34†
Legs/Feet	16,657†	26†
Hip	12,011‡	19‡
Trunk	5,736†	9†
All others	8,687†	13†

***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
***Notes:** See Appendix Table A for sample counts. Because of rounding, detail may not add to total.*
† Coefficient of variation between 16.6% and 25.0%
‡ Coefficient of variation between 25.1% and 33.3%

Table 2
Medication use in past month and selected characteristics, by sex, household population aged 65 or older, Canada excluding territories, 1996/97

	Total	Men	Women
		%	
Medication use			
Antidepressants	4	4†	5
Diuretics/Antihypertensives	36	32	40*
Heart medication	19	21	17*
Sleep medication	8	7	9*
Tranquilizers	5	3	6
Age			
65-74	61	63	60
75+	39	37	40
Household income			
Higher	61	68	56*
Lower	19	14	23*
Missing	20	18	21*
Alcohol use			
Less than daily	90	85	93*
Daily	9	14	6*
Missing	1	1	1†
Smoking			
Never	44	26	58*
Ever smoked	56	74	42*
Chronic conditions			
Arthritis/Rheumatism	42	34	49*
Diabetes	11	12	9
Effects of stroke	4	5	3
Urinary incontinence	6	4	7*
Impaired vision	5	4	7*
Body Mass Index (BMI)			
Not underweight (BMI ≥ 20)	88	93	85*
Underweight (BMI < 20)	8	5	11*
Missing	4	2	5*

***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
***Notes:** See Appendix Table B for sample counts. Because of rounding, detail may not add to total.*
‡ Coefficient of variation between 16.6% and 25.0%
** Significantly different from estimate for other sex*

medications with fall-related fractures in the household population aged 65 or older, while controlling for numerous factors that may also affect the risk.

Many fractures

As a result of the most serious activity-limiting injury they experienced in 1996/97, an estimated 65,000 people aged 65 or older (22,000 men and 43,000 women) sustained a fall-related fracture. About one-

Table 3
Adjusted odds ratios of fall-related fracture for selected covariates, household population aged 65 or older, Canada excluding territories, 1996/97

Risk factor	Adjusted odds ratio	95% confidence interval
Medication use†		
Antidepressants	0.7	0.3, 1.7
Diuretics/Antihypertensives	0.5*	0.3, 0.9
Heart medication	1.6	0.9, 2.9
Sleep medication	0.7	0.3, 1.8
Tranquilizers	1.3	0.5, 3.6
Age		
65-74‡	1.0	...
75+	1.7*	1.0, 2.7
Female§	1.2	0.6, 2.2
Household income		
Higher‡	1.0	...
Lower	1.5	0.8, 3.1
Alcohol use		
Less than daily‡	1.0	...
Daily	0.8	0.4, 1.5
Smoking		
Never‡	1.0	...
Ever	0.9	0.5, 1.5
Chronic conditions††		
Arthritis/Rheumatism	1.9*	1.2, 3.0
Diabetes	0.8	0.3, 2.2
Effects of stroke	2.3	0.4, 13.4
Urinary incontinence	2.9*	1.1, 7.2
Impaired vision	2.0	0.7, 6.2
Body mass index (BMI)		
Not underweight‡ (BMI ≥ 20)	1.0	...
Underweight (BMI < 20)	2.1*	1.0, 4.3

***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
***Notes:** Because of rounding, some confidence intervals with 1.0 as the lower limit were significant. Analysis is based on 13,156 people. An "unknown" category for household income, alcohol use, and body mass index was included in the model, but the respective odds ratios are not shown.*
† Reference category is not using medication.
‡ Reference category for which odds ratio is 1.0.
§ Reference category is male.
†† Reference category is absence of the condition.
** $p < 0.05$*
··· Not applicable

third of these fractures were of the arms/hands; another quarter, of the legs/feet. Nearly one-fifth of fractures (12,000) were of the hip (Table 1).

Medication use common

More than one-third of seniors reported that they used antihypertensives, diuretics or both, and 19% reported the use of heart medication (Table 2). Sleep medication was reported by 8%, aged 65 or older, and tranquilizer and antidepressant use, by 5% and 4%, respectively. The use of diuretics/antihypertensives and sleep medication was more common among women, while heart medications were in greater use among men.

The causal pathway

Previous reports indicate that numerous factors alter the risk of falls and fall-related injuries. A number of chronic conditions, as well as some medications, have been associated with falls. But it is sometimes difficult to disentangle the effects of variables that are themselves related. For example, an association between falls and a medication might actually be due to another factor that has not been considered, such as the illness for which the medication is being taken. It is thus important to control for the effects of variables that could confound an apparent association.[4,5]

Where possible, multiple logistic regression models of fall-related fractures were constructed to include not only independent variables for medications, but also variables to control for any effects of underlying disease. For example, a variable for high blood pressure was entered in a model with diuretics/antihypertensives (data not shown). High blood pressure was not associated with any altered risk of fracture, suggesting that it is the medication, not the condition for which it is indicated, that is associated with the lower odds of fracture. Similarly, heart disease was included in a model with heart medications and diuretics/antihypertensives (data not shown). The odds ratio for heart disease was not significant.

Because previous research has shown arthritis to be related to falls, it was included in the model as a control variable. To verify that the elevated odds ratio observed for arthritis was associated with the condition rather than with medications taken for it, a variable for pain medication was also included in the model: its odds ratio was not significant (data not shown). These findings suggest that arthritis has an effect independent of analgesics taken by people with the condition.

The only one of these categories of drugs associated with fractures was diuretics/antihypertensives. The odds ratio of fracture among individuals using diuretics or antihypertensives was half that of people not using these drugs (Table 3). This is consistent with numerous reports in the literature. Although the cross-sectional nature of the NPHS data limits the interpretation of observed associations, several large prospective studies carried out in the United States show a protective effect of thiazide diuretics against fracture.[11,12,34] The lowered risk of fracture is thought to relate to the effects of thiazide diuretics in reducing calcium excretion in urine, which results in a positive effect on bone density[11-14,34-36] (see *The causal pathway*).

In contrast to other research,[4,7,37] the NPHS data revealed no association between the use of antidepressants or tranquilizers and fall-related fractures. This may have resulted from the relatively small numbers reporting the use of these medications rather than a true lack of association.

Body mass, chronic conditions

The odds of a fracture were elevated among individuals with a low body mass index. However, because the NPHS data are self-reported and people tend to overstate their height—especially as they get older—the NPHS may overestimate the prevalence of underweight.[38] But despite the probable misclassification of some seniors who were actually the appropriate weight for their height, an association between underweight and fracture persisted. This relationship, which has previously been observed in prospective studies as well as others, relates to lower bone mineral density in people of lower body weight.[17,28,29,39-41]

The association of low body mass with fracture probably also reflects less muscle mass, poor nutrition and greater frailty, factors also related to risk of fracture. The percentage of underweight people who reported their general health as poor or fair was 28%, compared with 22% of those who were not underweight (data not shown).

The odds of fracture among seniors with arthritis/rheumatism or urinary incontinence were significantly elevated, indicating independent

associations with fracture even after controlling for age and other factors. These findings corroborate previously published studies.[9,26,42,43] The physiological relationship between arthritis/rheumatism and fall-related fracture arises from the mobility problems imposed by this disease. For urinary incontinence, the association is probably less direct. Earlier research linking urinary incontinence with hip fracture reported a higher prevalence of neurological disorders in incontinent women than in others.[26] Disorders such as Parkinson's disease and dementia give rise to a cluster of symptoms, including incontinence and gait and balance disturbances. The latter problems are more likely to account for the increase in fall-related injury than urinary incontinence per se. The cross-sectional nature of the NPHS data precluded any interpretation of an association between mobility problems and fall-related fracture. It is possible that urinary incontinence is a proxy for mobility problems arising from neurological disorders.

Concluding remarks

This analysis is the first use of population-based, nationally representative data to examine medication use in relation to fall-related fractures among the elderly. The findings are fairly consistent with other studies, except for the lack of association between tranquilizer use and fall-related injury. Although the cross-sectional nature of the data limits the

Definitions

National Population Health Survey (NPHS) respondents were asked if, in the year before the survey, they had experienced any injury serious enough to limit their normal activities. Those who reported at least one such injury were asked about the type (for example, broken bone or burn) of their most serious injury, the body part injured, and what caused the injury (for example, fall, motor vehicle accident, physical assault). Because the NPHS collected data on only the single most serious activity-limiting injury sustained over the previous 12 months, it was not possible to measure the number and frequency of fall-related fractures.

Data on *medication use* were based on responses to the question, "In the past month, did you take any of the following medications?" Those included for this analysis were "antidepressants," "diuretics or water pills," "medicine for blood pressure," "medicine for the heart," "sleeping pills," and "tranquilizers such as Valium."

A variable for *age* was included in the regression analysis. Age was categorized into two groups: 65 to 74 and 75 and older.

Household income levels were defined as "lower" and "higher," based on total household income and the number of people in the household:

	Income level	
People in household	**Lower**	**Higher**
1 or 2	Less than $15,000	$15,000 or more
3 or 4	Less than $20,000	$20,000 or more
5 or more	Less than $30,000	$30,000 or more

Data on income were unavailable for 20% of respondents aged 65 or older. So that other information about these people could be included in the regression analysis, a variable for unknown income was included in the model.

On the basis of previous research, four *chronic conditions* (arthritis/rheumatism, diabetes, effects of stroke and urinary incontinence) and limited vision were examined in relation to fracture risk.[9,25,26,37,44] The NPHS asked, "Does . . . have any of the following long-term conditions (conditions that have lasted or are expected to last six months or more) that have been diagnosed by a health professional?" *Impaired vision* was defined as any problem seeing that was not correctable by lenses.

Variables for alcohol use, smoking and body mass, all of which have been reported to relate to fracture risk in the elderly, were included in the analysis.[23,28,45-48] Frequency of *alcohol use* was categorized as less than daily (including never) or daily. *Smoking* was dichotomized as either never having smoked or ever having smoked. *Body mass index* (BMI), which is calculated by dividing weight in kilograms by height in metres squared, was grouped into two categories: not underweight (a BMI of 20 or more) and underweight (a BMI of less than 20). For example, underweight would be equivalent to less than 50 kg (110 pounds) for a person 160 cm (63 inches) tall, or less than 60 kg (132 pounds) for a person 173 cm (68 inches) tall.

interpretation of the findings, the inclusion of several relevant variables available from the National Population Health Survey in the multivariate analysis diminishes the potential for observing associations that are actually due to confounding factors.

This analysis supports the evidence that people using medications to treat high blood pressure are at reduced risk for fracture. Noting that thiazide diuretics have a low risk of serious side effects, at least one observer has mentioned (but not advocated) the possibility of their general use in elderly people to prevent bone loss.[40] However, this practice is not currently widespread.

The NPHS data also echo reports of the added risk of fracture conferred by low body weight. Except in cases when low weight results from debilitating chronic illness, helping underweight seniors achieve or maintain an appropriate body weight could lower their risk of fracture. However, because low body mass affects only a small percentage of the elderly population, the number of preventable fractures among such individuals is much lower than among people with other more common risk factors such as arthritis.

Even after age and other related characteristics were controlled, arthritis and urinary incontinence were each associated with increased odds of fracture. Research on community-dwelling seniors identified as being at high risk of fracture suggests that exercise and education programs could be effective in preventing falls and reducing fall-related injury. Interventions tailored to the needs of the individual, including balance or strengthening exercises, gait training and teaching in the use of assistive devices, were associated with a reduction in falls and fall-related injuries.[49] Because of the extent of falls and fall-related injuries in the senior population, it has been recommended that an assessment of risk factors of falling, followed by intervention programs as appropriate, should be a routine part of the health care of patients older than 75.[50] The benefits of such an approach could be considerable, especially if undertaken with people who have a condition such as arthritis that puts them at risk of fall-related fractures. ●

References

1 Wilkins K. Health care consequences of falls for seniors. *Health Reports* (Statistics Canada, Catalogue 82-003) 1999; 10(4): 47-55.

2 Millar WJ. Multiple medication use among seniors. *Health Reports* (Statistics Canada, Catalogue 82-003-XPB) 1998; 9(4): 11-7.

3 Swift CG, Ewen JM, Stevenson IH. Responsiveness to oral diazepam in the elderly: relationship to total and free plasma concentrations. *British Journal of Clinical Pharmacology* 1985; 20: 111-8.

4 Cumming RG, Miller JP, Kelsey JL, et al. Medications and multiple falls in elderly people: the St. Louis OASIS Study. *Age and Ageing* 1991; 20: 455-461.

5 Cumming RG. Epidemiology of medication-related falls and fractures in the elderly. *Drugs and Aging* 1998; 12(1): 43-53.

6 Ray WA, Griffin MR, Schaffner W, et al. Psychotropic drug use and the risk of hip fracture. *The New England Journal of Medicine* 1987; 316(7): 363-9.

7 Cummings SR, Nevitt MC, Browner WS, et al. Risk factors for hip fracture in white women. *The New England Journal of Medicine* 1995; 332(12): 767-73.

8 Grad RM. Benzodiazepines for insomnia in community-dwelling elderly: a review of benefit and risk. *Journal of Family Practice* 1995; 41(5): 473-81.

9 Graafmans WC, Ooms ME, Hofstee HMA, et al. Falls in the elderly: A prospective study of risk factors and risk profiles. *American Journal of Epidemiology* 1996; 143(11): 1129-36.

10 O'Loughlin JL, Robitaille Y, Boivin J-F, et al. Incidence of and risk factors for falls and injurious falls among the community-dwelling elderly. *American Journal of Epidemiology* 1993; 137(3): 342-54.

11 Felson DT, Sloutskis D, Anderson JJ, et al. Thiazide diuretics and the risk of hip fracture. Results from the Framingham Study. *Journal of the American Medical Association* 1991; 265(3): 370-3.

12 LaCroix AZ, Wienpahl J, White LR, et al. Thiazide diuretic agents and the incidence of hip fracture. *The New England Journal of Medicine* 1990; 322(5): 286-90.

13 Ray WA, Griffin MR, Downey W, et al. Long-term use of thiazide diuretics and risk of hip fracture. *The Lancet* 1989; 1: 687-90.

14 Jones G, Nguyen T, Sambrook PN, et al. Thiazide diuretics and fractures: can meta-analysis help? *Journal of Bone and Mineral Research* 1995; 10(1): 106-11.

15 Tambay J-L, Catlin G. Sample design of the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(1): 29-38.

16 Swain L, Catlin G, Beaudet MP. The National Population Health Survey—its longitudinal nature. *Health Reports* (Statistics Canada, Catalogue 82-003) 1999; 10(4): 69-82.

17 Krogh CM, editor-in-chief. *Compendium of Pharmaceuticals and Specialties*. Ottawa, Ontario: Canadian Pharmaceutical Association, 1994.

18 Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research*, 1996; 5: 283-310.

19 Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1992; 18(2): 209-17.

20 Blake AJ, Morgan K, Bendall MJ, et al. Falls by elderly people at home: prevalence and associated factors. *Age and Ageing* 1988; 17(6): 365-72.

21 Myers AH, Baker SP, VanNatta ML, et al. Risk factors associated with falls and injuries among elderly institutionalized persons. *American Journal of Epidemiology* 1991; 133: 1179-90.

22 Farmer ME, Harris T, Madans JH, et al. Anthropometric indicators and hip fracture: the NHANES I epidemiologic follow-up study. *Journal of the American Geriatric Society* 1989; 37: 9-16.

23 Meyer HE, Tverdal A, Falch JA. Body height, body mass index, and fatal hip fractures: 16 years' follow-up of 674,000 Norwegian women and men. *Epidemiology* 1995; 6(3): 299-305.

24 Health and Welfare Canada. *Canadian Guidelines for Better Weights* (Catalogue H39-134/1988E) Ottawa: Supply and Services Canada, 1988.

25 Dunn JE, Rudberg MA, Furner SE, et al. Mortality, disability, and falls in older persons: The role of underlying disease and disability. *American Journal of Public Health* 1992; 82(3): 395-400.

26 Johansson C, Hellström L, Ekelund P, et al. Urinary incontinence: a minor risk factor for hip fractures in elderly women. *Maturitas* 1996; 25(1): 21-8.

27 Paganini-Hill A, Chao A, Ross RK, et al. Exercise and other factors in the prevention of hip fracture: The Leisure World Study. *Epidemiology* 1991; 2(1): 16-25.

28 Ensrud KE, Lipschutz RC, Cauley JA, et al. Body size and hip fracture risk in older women: A prospective study. *American Journal of Medicine* 1997; 103: 274-80.

29 Cooper C, Barker DJP, Wickham C. Physical activity, muscle strength, and calcium intake in fracture of the proximal femur in Britain. *British Medical Journal* 1998; 297: 1443-6.

30 Will JC, Denny C, Serdula M, et al. Trends in body weight among American Indians: Findings from a telephone survey, 1985 through 1996. *American Journal of Public Health* 1999; 89(3): 395-8.

31 Galuska DA, Serdula M, Pamuk E, et al. Trends in overweight among US adults from 1987 to 1993: A multistate telephone survey. *American Journal of Public Health* 1996; 86(12):1729-35.

32 Kuczmarski RJ, Flegal KM, Campbell SM, et al. Increasing prevalence of overweight among US adults. *Journal of the American Medical Association* 1994; 272(3): 205-11.

33 Tully P, Mohl C. Older residents of health care institutions. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(3): 27-30.

34 Feskanich D, Willett WC, Stampfer MJ, et al. A prospective study of thiazide use and fractures in women. *Osteoporosis International* 1997; 7: 79-84.

35 Nguyen TV, Eisman JA, Kelly PJ, et al. Risk factors for osteoporotic fractures in elderly men. *American Journal of Epidemiology* 1996; 144(3): 255-63.

36 Herings RM, Stricker BH, de Boer A, et al. Current use of thiazide diuretics and prevention of femur fractures. *Journal of Clinical Epidemiology* 1996; 49(1): 115-9.

37 Koski K, Luukinen H, Laippala P, et al. Physiological factors and medications as predictors of injurious falls by elderly people: A prospective population-based study. *Age and Ageing* 1996; 25: 29-38.

38 Millar WJ. Distribution of body weight and height: Comparison of estimates based on self-reported and observed measures. *Journal of Epidemiology and Community Health* 1986; 40:319-23.

39 Cummings SR, Kelsey JL, Nevitt MC, et al. Epidemiology of osteoporosis and osteoporotic fractures. *Epidemiologic Reviews* 1985; 7: 178-207.

40 Hemenway D, Colditz GA, Willett WC, et al. Fractures and lifestyle: Effect of cigarette smoking, alcohol intake, and relative weight on the risk of hip and forearm fractures in middle-aged women. *American Journal of Public Health* 1988; 78(12): 1554-8.

41 Malmivaara A, Heliövaara M, Knekt P, et al. Risk factors for injurious falls leading to hospitalization or death in a cohort of 19,500 adults. *American Journal of Epidemiology* 1993; 138(6): 384-94.

42 Sartoretti C, Sartoretti-Schefer S, Ruckert R, et al. Comorbid conditions in old patients with femur fractures. *Journal of Trauma* 1997; 43(4): 570-7.

43 Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. *The New England Journal of Medicine* 1988; 319(26): 1701-7.

44 Prudham D, Grimley Evans J. Factors associated with falls in the elderly: a community study. *Age and Ageing* 1981; 10: 141-6.

45 Felson DT, Kiel DP, Anderson JJ, et al. Alcohol consumption and hip fractures: The Framingham Study. *American Journal of Epidemiology* 1988; 128(5): 1102-10.

46 La Vecchia C, Negri E, Levi F, et al. Cigarette smoking, body mass and other risk factors for fractures of the hip in women. *International Journal of Epidemiology* 1991; 20(3): 671-7.

47 Law MR, Hackshaw AK. A meta-analysis of cigarette smoking, bone mineral density and risk of hip fracture: recognition of a major effect. *British Medical Journal* 1997; 315: 841-6.

48 Cumming RG, Klineberg RJ. Case-control study of risk factors for hip fractures in the elderly. *American Journal of Epidemiology* 1994; 139(5): 493-503.

49 Tinetti ME, Baker DI, McAvay G, et al. A multifactorial intervention to reduce the risk of falling among elderly people living in the community. *The New England Journal of Medicine* 1994; 331(13): 821-7.

50 Tinetti ME, Speechley M. Prevention of falls among the elderly. *The New England Journal of Medicine* 1994; 320(16); 1055-9.

Appendix

Table A

Counts of fall-related fractures arising from most serious activity-limiting injury, by fracture site, household sample aged 65 or older, Canada excluding territories, 1996/97

Fracture site	Number
Total sample	**281**
Arms/Hands	79
Legs/Feet	63
Hip	62
Trunk	36
All others	41

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*

Table B

Counts of medication use in past month, selected characteristics, by sex, household sample aged 65 or older, Canada excluding territories, 1996/97

	Total	Men	Women
Total sample	**13,363**	**5,357**	**8,006**
Medication use			
Antidepressants	522	155	367
Diuretics/Antihypertensives	5,060	1,737	3,323
Heart medication	2,577	1,166	1,411
Sleep medication	1,004	302	702
Tranquilizers	567	148	419
Age			
65-74	7,780	3,390	4,390
75+	5,583	1,967	3,616
Household income			
Lower	2,780	762	2,018
Higher	7,119	3,301	3,818
Missing	3,464	1,294	2,170
Alcohol use			
Less than daily	11,925	4,475	7,450
Daily	1,207	793	414
Missing	231	89	142
Smoking			
Never	6,221	1,519	4,702
Ever	7,034	3,801	3,233
Missing	108	37	71
Chronic conditions			
Arthritis/Rheumatism	6,256	1,975	4,281
Diabetes	1,314	593	721
Effects of stroke	555	269	286
Urinary incontinence	904	306	598
Impaired vision	721	220	501
Body mass index (BMI)			
Not underweight (BMI $\geq$ 20)	11,870	5,048	6,822
Underweight (BMI < 20)	953	194	759
Missing	540	115	425

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*

Dental insurance and use of dental services

Wayne J. Millar and David Locker

Abstract

Objectives

This article examines socioeconomic differences in insurance for dental services among Canadians aged 15 or older and factors associated with the use of dental services.

Data source

The data on dental insurance coverage and use of dental services are from the cross-sectional file of Statistics Canada's 1996/97 National Population Health Survey. The sample size of respondents aged 15 or older was 70,884.

Analytical techniques

Logistic regression analysis was used to model variables related to dental insurance coverage and to dental visits in the past year. A weighted bootstrap resampling procedure was used to derive variance estimates.

Main results

In 1996/97, 53% of the population aged 15 or older reported having dental insurance, and 59% said they had visited a dentist in the past year. But even when they had insurance, individuals with low incomes and low educational attainment had much lower odds of visiting a dentist than those with higher incomes and more education.

Key words

dental care, dental health services, health surveys, socioeconomic status

Authors

Wayne J. Millar (613-951-1631; millway@statcan.ca) is with the Health Statistics Division at Statistics Canada, Ottawa K1A 0T6, and David Locker is with the Department of Community Dentistry at the University of Toronto, Toronto M5G 1G6.

Dental disease may be one of the most common health problems in the world today. Yet because it is generally neither dramatic nor life-threatening, its public health impact has not been fully appreciated.[1] Recent research suggests that dental health can affect the functional, psychological and social dimensions of an individual's overall health status.[2] Dental problems are also associated with a substantial reduction of daily activity, with loss of work and school days.[3]

Because dental health is an important part of overall health status, it is important that all Canadians receive adequate dental care. Oral diseases and dental problems, in fact, are largely preventable. Regular check-ups (at least one visit within a one- or two-year period) are important for everyone. Even individuals with no natural teeth can benefit from seeing a dentist regularly to follow up and maintain dental prostheses, or to screen for oropharyngeal cancer or non-cancerous lesions.[4]

Dental visits are largely determined by the ability to pay for services. Per person visits tend to increase with household income because dental care, especially

preventive care, is elective. Research in Great Britain, Australia and the United States has provided evidence that individuals with lower socioeconomic status use preventive dental services less often.[5-7] Further, numerous studies have documented that members of lower socioeconomic groups have poorer dental health than individuals belonging to more affluent groups.[5,8,9]

In Canada, several reports have noted disparities in dental care utilization by socioeconomic status.[8] A Québec analysis found that income and education were among the factors most strongly related to the use of dental services.[5] A study of older Ontario adults found that the likelihood of visiting a dentist was highly associated with dental insurance.[12] Income was also a factor in dental visits; the lowest rates were observed among low income persons without insurance.[12]

This article uses data from the 1996/97 National Population Health Survey (NPHS) to examine the extent to which Canadians are covered by dental insurance, and how such coverage affects their use

Methods

Data sources

This article is based on data from Statistics Canada's National Population Health Survey (NPHS). The NPHS, which began in 1994/95, collects information about the health of the Canadian population every two years.[10,11] It covers household and institutional residents in all provinces and territories, except persons living on Indian reserves, on Canadian Forces bases, and in some remote areas. The NPHS has both a longitudinal and a cross-sectional component. Respondents who are part of the longitudinal component will be followed for up to 20 years.

The 1996/97 cross-sectional sample is made up of longitudinal respondents and respondents who were selected as part of supplemental samples, or buy-ins, in three provinces. The additional respondents were chosen with random digit dialing (RDD) and were included for cross-sectional purposes only.

Individual data are organized into two files: General and Health. Socio-demographic and some health information was obtained for each member of participating households. These data are found in the General file. Additional in-depth health information was collected for one randomly selected household member. The in-depth health information, as well as the information on the General file pertaining to that individual, is found in the Health file.

In households belonging to the cross-sectional buy-in component, one knowledgeable person provided the socio-demographic and health information about all household members for the General file. As well, one household member, not necessarily the same person, was randomly selected to provide in-depth health information about himself or herself for the Health file.

Among individuals in the longitudinal component, the person providing in-depth health information about himself or herself for the Health file was the randomly selected person for that household in cycle 1 (1994/95) and was usually the person who provided information on all household members for the General file in cycle 2 (1996/97).

The 1996/97 cross-sectional response rates for the Health file were 93.1% for the continuing longitudinal component and 75.8% for the RDD component, yielding an overall response rate of 79.0%. Information in the Health file is available for 81,804 randomly selected respondents.

This analysis is based on the sample of 70,884 Canadians who were aged 15 or older. It uses cross-sectional data from cycle 2 of the NPHS to examine dental insurance coverage and use of dental services. The data analyzed here pertain to the household population in the 10 provinces (Appendix Table A).

Supplemental information was obtained from the 1990 Health Promotion Survey, which was conducted for Health Canada.

Analytical techniques

Unadjusted and adjusted odds ratios were calculated to investigate the association between socioeconomic characteristics, dental insurance, and dental visits in the past year.

All estimates based on NPHS data were weighted to represent the Canadian population at the date of the survey. The 1996/97 population of Canada aged 15 or older (both sexes) was used as the reference population for direct standardization of rates. A weighted bootstrap resampling procedure was used to calculate coefficients of variation for totals and rates.[13,14] This technique also served to estimate standard errors used in the calculations of the confidence intervals for the odds ratios. Results at the 0.05 level were considered statistically significant.

of dental services (see *Methods, Limitations* and *Definitions).*

Half covered by dental insurance

The cost of dental care is generally the responsibility of the individual. Many may benefit from coverage provided through private dental care plans, which are often available through employment. Others may be eligible for coverage under one of the provincial plans. Most provinces provide coverage for children, seniors and social assistance recipients.[15] A few provinces (British Columbia, Québec and Newfoundland) have special preventive dentistry programs for children.[16]

According to the 1996/97 NPHS, about half of Canadians aged 15 or older (53%) reported having dental insurance (Table 1). Coverage tended to be highest among middle-aged people. While just over half of individuals aged 15 to 24 (54%) said they had dental insurance, the rate rose to 64% for those aged 35 to 44. At older ages, the rate dropped, and

Limitations

In an effort to be as inclusive as possible, the National Population Health Survey (NPHS) referred to "insurance" rather than "dental plan coverage." However, dental plan coverage is not actually a form of insurance, but an economic benefit that prepays some or all of an individual's dental care costs.

As well, the estimates of dental insurance reflect the perception of the individual. It is possible that some respondents may have misinterpreted the question about dental insurance coverage. For example, when asked if they currently had "insurance that covers all or part of your dental expenses," some may not have been aware that they had coverage under a spouse's or parent's plan, or under a school or sports-affiliated plan. It is also possible that some respondents who reported having dental insurance coverage received that coverage under a social assistance plan, which would cover basic emergency dental care only. Others may not have considered dental services provided under provincial social assistance programs as dental insurance.

The NPHS data do not indicate the scope or type of coverage for dental services. There is no information about the proportion of the cost that individuals would be expected to pay, although such an expense could influence their use of dental services.

The NPHS did not ask respondents if they had their own natural teeth. Therefore, it is not possible to identify the dentate and edentate populations using NPHS data. The 1990 Health Promotion Survey, however, did ask respondents about the number of teeth; those who had no natural teeth were classified as edentate.[17]

Table 1

Household population aged 15 or older with dental insurance, by selected socioeconomic characteristics, Canada excluding territories, 1996/97

	Total population	Population with dental insurance	
	'000	'000	Age-adjusted %
Both sexes	**23,444**	**12,318**	**53**
Men	11,519	6,119	53
Women	11,925	6,199	53
Age group			
15-24	3,983	2,147	54
25-34	4,472	2,620	59
35-44	5,238	3,362	64
45-54	3,771	2,299	61
55-64	2,565	1,159	45
65 or older	3,416	730	21
Province			
Newfoundland	449	178	39
Prince Edward Island	107	51	48
Nova Scotia	738	357	49
New Brunswick	607	312	51
Québec	5,862	2,283	39
Ontario	8,879	5,305	60
Manitoba	857	470	56
Saskatchewan	752	363	50
Alberta	2,121	1,222	57
British Columbia	3,072	1,777	58
Residence			
Rural	4,047	1,863	46
Urban	19,388	10,448	54
Missing	10	7	- -
Household income			
Lowest/Lower-middle	3,051	680	23
Middle	5,865	2,396	42
Upper-middle	7,655	5,082	64
Highest	2,966	2,213	70
Missing	3,906	1,948	51
Educational attainment			
Less than secondary graduation	6,377	2,488	40
Secondary graduation	3,909	2,094	53
Some postsecondary	5,398	2,933	53
Postesecondary graduation	7,595	4,734	59
Missing	165	69	49
Employment status			
Currently working	13,816	8,819	60
Not currently working†	8,234	3,167	41
Worked in last 12 months, current work status unknown	127	63	48
Missing	1,268	269	61

***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*

***Note:** Detail may not add to totals because of rounding.*

† Not currently working, but had a job, or did not work during last 12 months

- - Amount too small to provide reliable estimate

only one-fifth of the 65-or-older age group (21%) was covered. The unadjusted odds of having dental insurance were significantly higher for all age groups compared with the 65-or-older group (Appendix Table B).

The high coverage among the middle age groups may reflect benefits that are often offered through employment. In fact, among those who were working, the rate of coverage was 60%, compared with 41% among those who were not working.

Dental insurance coverage was strongly associated with household income. At the highest income level the rate was about triple that for the lowest (70% compared with 23%). The rate of coverage also rose with level of education, but the incremental change was less pronounced than that for household income.

Of course, age, employment status, income and education all tend to be related. After sex, age, province, residence, household income and employment status were taken into account, the odds that postsecondary graduates would have dental insurance coverage were higher than those for people with less than secondary graduation (Table 2). Similarly, each of the other variables was significantly related to having dental insurance. For example, the odds that people in the highest income group would report having insurance were more than seven times the odds of those in the lowest. As well, 35- to 44-year-olds had four times the odds

Definitions

National Population Health Survey (NPHS) respondents were asked, "Do you have insurance that covers all or part of your dental expenses?" Dental insurance status was dichotomized as insured or not insured. All information about dental insurance coverage is based on non-proxy responses.

Respondents were asked, "When was the last time that you went to a dentist?" Those who said "less than one year ago" were asked, "Why do you go to the dentist?" Interviewers did not read the following list but marked all that applied: to make sure everything is okay; check-up covered by insurance; catch problems early; for good dental health; to take care of teeth/gums/dentures; for cleaning/fluoride/maintenance; to get a filling/extraction; to check braces; other (specify). Respondents could give more than one reason.

Individuals who had not visited a dentist in the past year were asked when they had last done so. Those who had not visited a dentist in the past three years were asked, "Why haven't you been to a dentist in the past three years?" Again, interviewers did not read the list, but marked the appropriate responses: have not gotten around to it; respondent did not think it was necessary; dentist did not think it was necessary; personal or family responsibilities; not available at time required; not available at all in the area; waiting time was too long; transportation problems; language problem; cost; did not know where to go/uninformed; fear (painful, embarrassing, find something wrong, etc.); wears dentures; and other (specify).

Six *age groups* were established for this analysis: 15 to 24, 25 to 34, 35 to 44, 45 to 54, 55 to 64, and 65 or older.

Residence was classified as either rural or urban.

Four *household income* levels were defined by taking into account both household income and the number of people in the household:

Income group	Number of household members	Household income
Lowest/Lower-middle	1 or 2	Less than $14,999
	3 or 4	Less than $19,999
	5 or more	Less than $29,999
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 and over
	3 or 4	$80,000 and over
	5 or more	$80,000 and over

Educational attainment was grouped into four categories: less than secondary graduation; secondary graduation; some postsecondary; and postsecondary graduation.

Employment status was categorized as currently working, not currently working (that is, had a job but not currently working, or did not work in last 12 months), or worked in last 12 months, but current work status unknown.

of being insured as did seniors. The odds of being insured were also higher for women than men, for urban than rural residents, and for workers than for people who were not working.

Table 2
Adjusted odds ratios for dental insurance coverage, household population aged 15 or older, Canada excluding territories,1996/97

	Adjusted odds ratio	95% confidence interval
Sex		
Men	0.91*	0.84, 0.97
Women†	1.00	...
Age group		
15-24	3.96*	3.41, 4.60
25-34	3.26*	2.80, 3.78
35-44	4.27*	3.73, 4.89
45-54	3.47*	3.02, 3.97
55-64	2.21*	1.91, 2.56
65 or older†	1.00	...
Province		
Newfoundland†	1.00	...
Prince Edward Island	1.29	0.98, 1.69
Nova Scotia	1.28	0.99, 1.67
New Brunswick	1.45*	1.11, 1.87
Québec	0.68*	0.55, 0.84
Ontario	1.86*	1.53, 2.25
Manitoba	1.57*	1.29, 1.92
Saskatchewan	1.25	0.98, 1.60
Alberta	1.65*	1.35, 2.02
British Columbia	1.52*	1.19, 1.95
Residence		
Rural†	1.00	...
Urban	1.29*	1.18, 1.42
Household income		
Lowest/Lower-middle†	1.00	...
Middle	2.33*	2.05, 2.65
Upper-middle	5.99*	5.24, 6.83
Highest	7.39*	6.26, 8.73
Educational attainment		
Less than secondary graduation†	1.00	...
Secondary graduation	1.06	0.95, 1.19
Some postsecondary	1.04	0.93, 1.15
Postsecondary graduation	1.16*	1.05, 1.30
Employment status		
Currently working	1.40*	1.28, 1.53
Not currently working†‡	1.00	...
Worked in last 12 months, current work status unknown	1.06	0.67, 1.66

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
Notes: *The multivariate analysis is based on 63,118 persons aged 15 or older who provided information on all variables in the model. A "missing" category for income was included in the model to maximize the sample size; however, its odds ratio is not shown.*
† Reference category, for which odds ratio is 1.0
‡ Not currently working, but had a job, or did not work during last 12 months
** $p < 0.05$*
··· Not applicable

Use of dental services

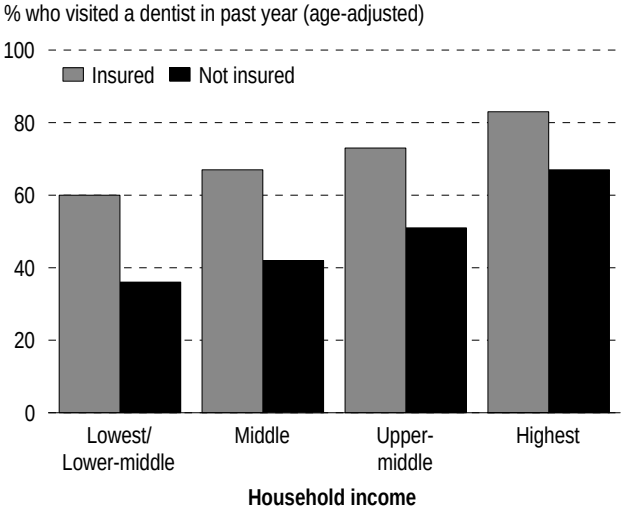
Almost 6 in 10 Canadians aged 15 or older (59%), or about 13.9 million people, said that they had visited a dentist in the year before their 1996/97 NPHS interview (Table 3, Appendix Table C). This was up from 47% in 1978/79.[18,19]

Women were more likely than men to have seen a dentist: 62% versus 56%. The proportion of the population who visited a dentist also varied by age. More than 60% of individuals aged 15 to 54 had visited a dentist, compared with 51% of 55- to 64-year-olds and 40% seniors.

There were large differences in dental visits by household income and educational attainment. While only 41% of people in the lowest income group had visited a dentist in the past year, 78% of individuals in the highest income group had done so. Similarly, 43% of those with less than secondary graduation reported a visit, compared with 70% of postsecondary graduates.

As might be expected, dental insurance was an important factor influencing dental visits. About three-quarters (73%) of individuals with insurance had visited a dentist in the past year, compared with

Chart 1
Household population aged 15 or older who visited a dentist in past year, by dental insurance status and household income, Canada excluding territories, 1996/97



Data source*: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
Note: *Both the gradients of the insured and not insured are significant; the differences within an income group by insurance status are also significant.*

Table 3
Household population aged 15 or older who visited a dentist in past year, by selected socioeconomic characteristics, Canada excluding territories, 1996/97

	Total population	Population who visited a dentist in past year	
	'000	'000	Age-adjusted %
Both sexes	**23,444**	**13,870**	**59**
Men	11,519	6,542	56
Women	11,925	7,328	62
Age group			
15-24	3,983	2,629	66
25-34	4,472	2,739	61
35-44	5,238	3,455	66
45-54	3,771	2,369	63
55-64	2,565	1,309	51
65 or older	3,416	1,370	40
Province			
Newfoundland	449	180	39
Prince Edward Island	107	60	57
Nova Scotia	738	403	55
New Brunswick	607	299	49
Québec	5,862	2,978	51
Ontario	8,879	6,028	68
Manitoba	857	489	58
Saskatchewan	752	339	46
Alberta	2,121	1,169	54
British Columbia	3,072	1,925	63
Residence			
Rural	4,047	2,145	53
Urban	19,388	11,718	60
Missing	10	7	- -
Household income			
Lowest/Lower-middle	3,051	1,223	41
Middle	5,865	3,004	52
Upper-middle	7,655	5,021	65
Highest	2,966	2,306	78
Missing	3,906	2,316	60
Educational attainment			
Less than secondary graduation	6,376	2,911	43
Secondary graduation	3,909	2,267	58
Some postsecondary	5,398	3,352	62
Postsecondary graduation	7,595	5,272	70
Missing	165	68	42
Employment status			
Currently working	13,816	8,992	62
Not currently working†	8,234	4,330	53
Worked in last 12 months, current work status unknown	126	76	49
Missing	1,268	473	59
Dental insurance			
Insured	12,318	9,170	73
Not insured	10,318	4,539	45
Missing	808	162	14

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
Note: *Detail may not add to totals because of rounding.*
† Not currently working, but had a job, or did not work during last 12 months
- - Amount too small to provide reliable estimate

45% of the non-insured. But although insurance coverage reduced the gap, even if they were insured, persons in lower income groups were not as likely as those in the higher income groups to have seen a dentist (Chart 1).

After controlling for sex, age, province, residence, household income, educational attainment, and employment status, the odds that individuals with insurance would have visited a dentist in the past year were 2.69 times higher than those of the uninsured group (Table 4). Similarly, the odds that individuals with the highest household income had visited a dentist were 2.76 times those of individuals in the lowest income group. And postsecondary graduates' odds of having seen a dentist were close to twice those of people who had not graduated from high school. As well, the odds of visiting a dentist in the past year were slightly higher for urban than for rural residents.

Dental visits were also associated with sex and age. Women had significantly higher odds than men of going to the dentist. The odds of reporting a dental visit were higher among people in the age groups between 15 and 54, compared with those aged 65 or older.

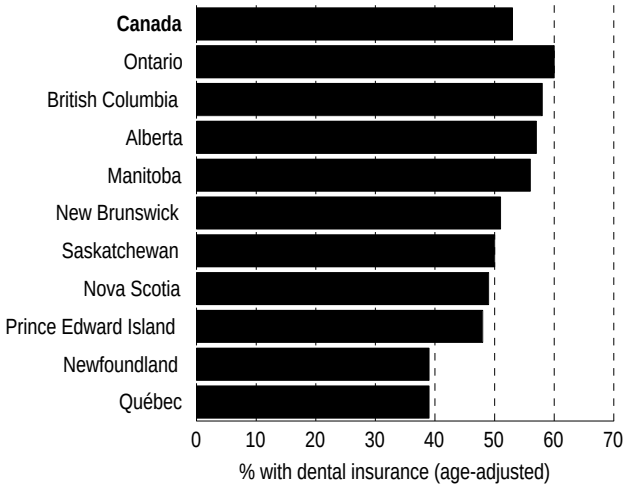
Although employment status was significantly associated with dental insurance coverage, this was not the case for dental visits. When other factors were taken into account, the odds that individuals who were working would report seeking dental care in the past year were no greater than the odds for those who were not working. An American study has noted the same phenomenon.[20]

Coverage, visits vary by province

Dental insurance coverage rates varied by province. The overall rate in Canada was 53%, and rates ranged from a high of 60% in Ontario to a low of 39% in Québec and Newfoundland (Chart 2). In comparison with Newfoundland, Ontario residents had almost twice the odds of reporting dental insurance (1.86), while their counterparts in Québec had signficantly low odds (0.68) (Table 2). The odds of having dental insurance were also significantly high in New Brunswick, the Prairie provinces (except Saskatchewan) and British Columbia, compared with Newfoundland.

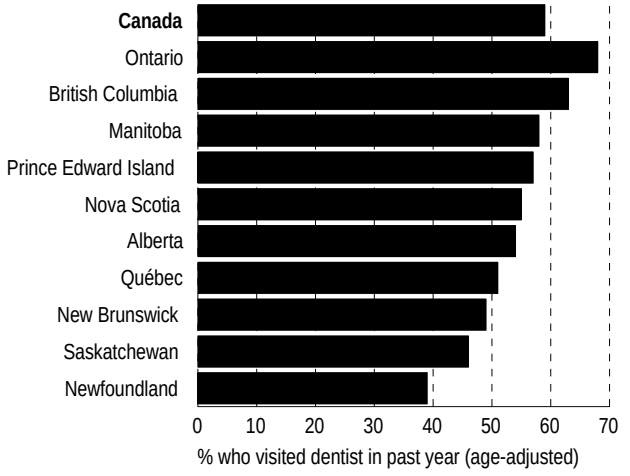
Newfoundland had the lowest provincial rate for dental visits, with only 39% reporting a visit in the past year (Chart 3). Ontario had the highest rate, at 68% (see *Population per dentist*). In fact, Ontario residents had 2.57 times the odds of visiting a dentist than their counterparts in Newfoundland (Table 4). When compared with Newfoundland, the odds of visiting a dentist were significantly high in all other provinces except New Brunswick and Saskatchewan.

Chart 2
Household population aged 15 or older with dental insurance, Canada excluding territories, 1996/97



***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*

Chart 3
Household population aged 15 or older who visited a dentist in past year, Canada excluding territories, 1996/97



***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*

Table 4
Adjusted odds ratios for dental visit in past year, household population aged 15 or older, Canada excluding territories, 1996/97

	Adjusted odds ratio	95% confidence interval
Sex		
Men†	1.00	…
Women	1.33 *	1.24, 1.43
Age group		
15-24	2.02 *	1.75, 2.34
25-34	1.17 *	1.00, 1.36
35-44	1.45 *	1.24, 1.69
45-54	1.27 *	1.09, 1.47
55-64	0.98	0.83, 1.16
65 or older†	1.00	…
Province		
Newfoundland†	1.00	…
Prince Edward Island	1.85 *	1.46, 2.34
Nova Scotia	1.70 *	1.31, 2.20
New Brunswick	1.27	0.99, 1.63
Québec	1.47*	1.18, 1.82
Ontario	2.57*	2.15, 3.09
Manitoba	1.64*	1.35, 2.00
Saskatchewan	1.08	0.82, 1.43
Alberta	1.38*	1.15, 1.66
British Columbia	1.86*	1.47, 2.34
Residence		
Rural†	1.00	…
Urban	1.10*	1.00, 1.22
Household income		
Lowest/Lower-middle†	1.00	…
Middle	1.33*	1.16, 1.51
Upper-middle	1.74*	1.54, 1.98
Highest	2.76*	2.32, 3.30
Educational attainment		
Less than secondary graduation†	1.00	…
Secondary graduation	1.29 *	1.17, 1.44
Some postsecondary	1.50 *	1.35, 1.66
Postsecondary graduation	1.92 *	1.70, 2.18
Employment status		
Currently working	0.96	0.87, 1.05
Not currently working†‡	1.00	...
Worked in last 12 months, current work status unknown	1.00	0.55, 1.79
Dental insurance		
Insured	2.69*	2.47, 2.93
Not insured†	1.00	…

***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
***Notes:** The multivariate analysis is based on 50,481 persons aged 15 or older who provided information on all variables in the model. A "missing" category for income was included in the model to maximize the sample size; however, its odds ratio is not shown. Because of rounding, some confidence intervals with 1.00 as the lower limit were significant.*
† Reference category, for which odds ratio is 1.00
‡ Not currently working, but had a job, or did not work during last 12 months.
** $p < 0.05$*
… Not applicable

Population per dentist

To some degree, dental visits may be affected by the availability of dental services. In 1992 (the most recent year for which data have been collected), there were 1,919 people for every dentist in Canada, an improvement over 1982 when the ratio had been 2,132 people per dentist.

Provincial population-to-dentist ratios varied substantially in 1992, from a high of 4,026 in Newfoundland to 1,600 in British Columbia. Although the ratio declined in all provinces between 1982 and 1992, the largest absolute declines occurred in Nova Scotia, Newfoundland and New Brunswick.

Population per active licensed dentist (full- and part-time), Canada, by province, 1982 and 1992

	1982	1992	Difference	% reduction
Canada	**2,132**	**1,919**	**213**	**10.0**
Newfoundland	4,491	4,026	465	10.4
Prince Edward Island	2,971	2,676	295	9.9
Nova Scotia	2,693	2,104	589	21.9
New Brunswick	3,606	3,160	446	12.4
Québec	2,493	2,180	313	12.6
Ontario	1,875	1,736	139	7.4
Manitoba	2,347	2,032	315	13.4
Saskatchewan	2,925	2,823	102	3.5
Alberta	2,120	1,860	260	12.3
British Columbia	1,637	1,600	37	2.3

Data source: *Table 7.2, Health Personnel in Canada, 1992, Health and Welfare Canada (reference 21)*

Reasons for visits

Most people who had visited a dentist in the past year reported that they had done so for routine care, including cleaning, fluoride treatment or maintenance (43%) (Table 5). Only 9% of respondents stated that they had gone to the dentist because they had insurance.

Reasons for seeking dental care varied considerably by household income. People in lower income households were less likely than those in high income households to mention preventive reasons. For example, about 36% of the lowest income group included procedures such as cleaning or fluoride treatment as a reason for a dental visit, compared with 48% of the highest income group. By contrast, 25% of the lowest income group cited a filling or extraction, compared with 13% of the highest income group.

The pattern was the same among those with and without dental insurance. Cleaning, fluoride treatment and maintenance were more common among the insured, while fillings and extractions were reported more often by non-insured respondents.

Table 5
Selected reasons for visiting dentist in past year,† household population aged 15 or older,† by household income and dental insurance status, Canada excluding territories, 1996/97

Household income and dental insurance status	Number	Reason for visiting dentist‡						
		Make sure everything is okay	Check-up insured	Catch problems early	Good dental health	Care of teeth/gums/ dentures	Cleaning/ Fluoride/ Maintenance	Filling/ Extraction
	'000	Age-adjusted %						
Total	**13,870**	**36**	**9**	**5**	**12**	**20**	**43**	**17**
Household income								
Lowest/Lower-middle	1,223	33	3	3	13	21	36	25
Middle	3,004	33	7	4	11	20	40	21
Upper-middle	5,021	38	10	6	13	19	42	15
Highest	2,306	37	12	6	15	21	48	13
Not stated	2,316	34	11	3	9	20	48	16
Dental insurance status								
Insured	9,170	36	14	5	13	20	44	15
Not insured	4,539	34	- -	4	12	20	40	21
Missing	162	40	3	1	15	20	45	18

Data source*: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
Note: *Detail may not add to totals because of rounding.*
† Based on respondents who saw a dentist in past year
‡ Respondents may have given more than one reason.

Table 6
Selected reasons for not visiting a dentist in past three years,† by household income and dental insurance status, household population aged 15 or older,† Canada excluding territories, 1996/97

Household income and dental insurance status	Number	Reason for not visiting dentist‡				
		Respondent deemed unnecessary	Wears dentures	Cost of dental care	Not gotten around to it	Pain or embarrassment
	'000			Age-adjusted %		
Total	**4,442**	**46**	**23**	**17**	**11**	**4**
Household income						
Lowest/Lower-middle	1,029	47	24	20	8	3
Middle	1,403	44	24	19	12	4
Upper-middle	1,129	48	23	13	11	5
Highest	179	38	22	10	16	7
Not stated	701	46	20	18	15	4
Dental insurance status						
Insured	1,240	47	24	6	15	7
Not insured	3,161	45	23	22	9	3
Missing	41	52	24	25	30	2

***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
***Note:** Detail may not add to totals because of rounding.*
† Based on respondents who saw a dentist in past three years.
‡ Respondents may have given more than one reason.

Reasons for not seeking dental care

Among individuals who reported that they had not visited a dentist in the past three years, many (46%) said they did not think it was necessary, and close to one-quarter (23%) reported wearing dentures (Table 6) (see *The edentate population*). Some respondents had simply "not gotten around to it," while a few cited "pain or embarrassment." About one-fifth (17%) said that cost had prevented them from visiting a dentist in the past three years.

Once again, differences by household income and insurance status were apparent. Individuals in the lowest income group stated that they did not believe dental treatment was necessary (47%) more often than did members of the highest income group (38%). And 20% of the lowest income group mentioned cost, compared with just 10% of the highest income group. Similarly, while 22% of the non-insured population cited cost as a factor, just 6% of the insured group gave cost as the reason for not seeing a dentist in the past three years.

Pain and embarrassment were more common reasons for avoiding dental visits among high income individuals and those with dental insurance than among people with lower incomes and no insurance. For instance, 7% of those in the highest income households and 7% of the insured gave these reasons for not seeing a dentist in the past three years. The corresponding figures were both 3% for those in the lowest/lower-middle income households and for the uninsured.

Concluding remarks

According to the 1996/97 National Population Health Survey, household income, educational attainment and dental insurance coverage were strongly associated with dental visits. It is clear that individuals in lower income groups use dental services less frequently.[22] And when they do seek dental care, it is less likely to be for preventive reasons and more likely to be because of a dental emergency. Among the upper income groups, treatment involves a wider range of services.[8]

Advances in dental care and treatment have made it possible for more people to keep their teeth for life. In large measure, this may reflect the increasing availability of dental insurance and growing public awareness of the importance of dental health.

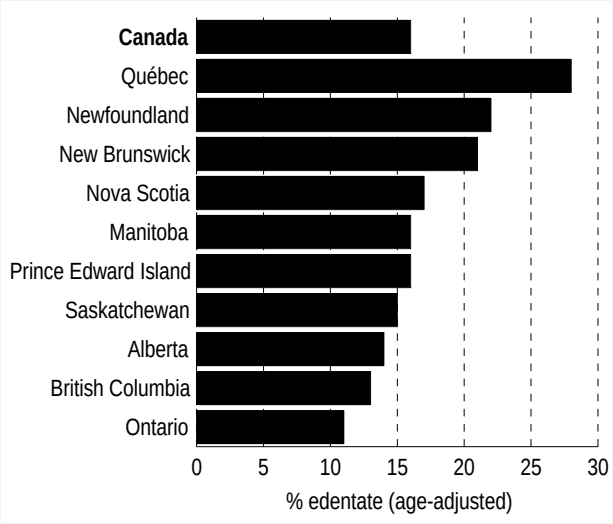
The edentate population

One measure of dental care is the proportion of the population that is edentate (have no natural teeth). The 1996/97 National Population Health Survey did not ask respondents about the number of teeth they had; the most recent information available is from the 1990 Health Promotion Survey. In 1990, 17% of Canadians aged 15 or older were edentate. At 28%, Québec had the highest rate of complete tooth loss, whereas the lowest rate, 11%, was in Ontario.

At all household income levels, individuals without dental insurance were more likely to be edentate. But dental insurance had little influence on the disparity between the lowest and highest income groups. Regardless of coverage, persons in lower income groups were more likely to be edentate. Among the insured, 25% in the lowest income group were edentate, compared with 2% in the highest income group.

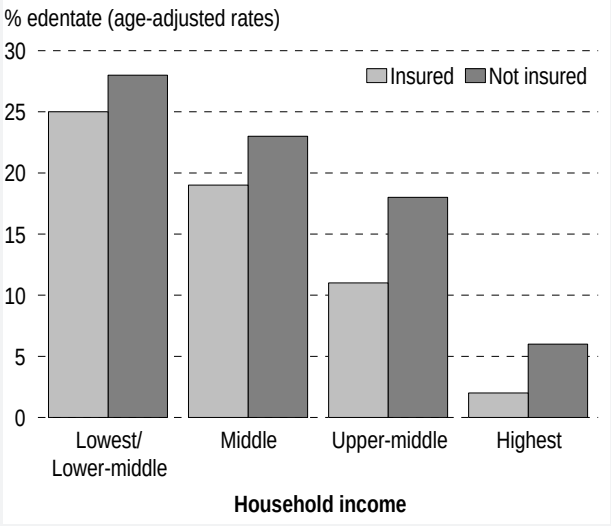
Edentualism was particularly prevalent among the elderly. In 1990, the rate among Canadians aged 65 or older was 50%. However, research suggests that the proportion of the elderly who have no teeth has declined.[23,24] This is likely attributable to improved access to dental care and widespread fluoridation of water.[25] As the population continues to age, the prevalence of edentualism in the population aged 65 or older is expected to decline even further.

Edentate population aged 15 or older, by province, 1990



***Data source**: 1990 Health Promotion Survey*

Edentate population aged 15 or older, by household income and dental insurance status excluding territories, Canada, 1990



***Data source:** 1990 Health Promotion Survey*
***Notes:** Both the insured and not insured gradients are significant at $p < .0001$. The differences within an income group by insurance status are significant except for the middle income group.*

References

1 Leske GS, Ripa LW, Leske CM, et al. Dental public health. In: Last JM, ed. *Maxcy-Rosenau Public Health and Preventive Medicine, 12th edition.* Norwalk, Connecticut: Appleton-Century-Crofts; 1995: 1473-514.

2 Gift HC, Atchison KA. Oral health, health, and health-related quality of life. *Medical Care* 1995; 33(11): NS57-72.

3 Gift HC, Reisine ST, Larach DC. The social impact of dental problems and visits. *American Journal of Public Health* 1992; 82(12): 1663-8.

4 Gilbert GH, Branch LG, Orav JE. Predictors of older adults' longitudinal dental care use: Ten-year results. *Medical Care* 1990; 28(12): 1165-80.

5 Brodeur JM, Benigieri M, Olivier M, et al. Use of dental services and the percentage of persons possessing private dental insurance in Quebec. *Journal of the Canadian Dental Association* 1996; 62(1): 83-90.

6 Eklund SA, Burt BA. Risk factors for total tooth loss in the United States: longitudinal analysis of national data. *Journal of Public Health Dentistry* 1994; 54(1): 5-14.

7 Roberts-Thompson K, Brennan DS, Spencer AJ. Social inequality in the use and comprehensiveness of dental services. *Australian and New Zealand Journal of Public Health* 1995; 19(1): 80-5.

8 Charette A. Dental health. In: Stephens T, Fowler Graham D, eds. *Canada's Health Promotion Survey, 1990*: *Technical Report* (Health and Welfare Canada, Catalogue H39-263/2-1990E) Ottawa: Minister of Supply and Services Canada, 1993: pp. 211-22.

9 Locker D, Leake JL. Income inequalities in oral health among older adults in four Ontario communities. *Canadian Journal of Public Health* 1992; 83(2): 150-4.

10 Tambay J-L, Catlin G. Sample design of the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 1995; 7(1): 29-38.

11 Swain L, Catlin G, Beaudet MP. The National Population Health Survey—its longitudinal nature. *Health Reports* (Statistics Canada, Catalogue 82-003) 1999; 10(4): 69-82.

12 Locker D, Leake JL. Inequities in health: Dental health insurance coverage and use of dental services among older Ontario adults. *Canadian Journal of Public Health* 1993; 84(2): 139-40.

13 Rao JNK, Wu CFJ, Yue K. Some recent work on resampling methods for complex surveys. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1992; 18(2); 209-17.

14 Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5: 283-310.

15 Buske L. What's covered? What's not? *Canadian Medical Association Journal* 1998; 159(1/0120e). Available at http://www.cma.ca/cmaj/vol-159/issue-1/0120e.html. Accessed June 15, 1999.

16 Shah CP. *Public Health and Preventative Medicine in Canada,* 4th ed. Toronto: University of Toronto Press, 1998.

17 Stephens T, Fowler Graham D, eds. *Canada's Health Promotion Survey, 1990*: *Technical Report* (Health and Welfare Canada, Catalogue H39-263/2-1990E) Ottawa: Minister of Supply and Services Canada, 1993.

18 Statistics Canada and Health and Welfare Canada. *The Health of Canadians. Report of the Canada Health Survey* (Statistics Canada, Catalogue 82-538E) Ottawa: Minister of Supply and Services Canada, 1981.

19 Stephens T, ed. *Health Status of Canadians*: *Report of the 1991 General Social Survey* (Statistics Canada, Catalogue 11-612E, No. 8) Ottawa: Minister of Industry, Science and Technology, 1994.

20 Manski RJ, Magder LS. Demographic and socioeconomic predictors of dental care utilization. *Journal of the American Dental Association* 1998; 129: 195-200.

21 Health and Welfare Canada. *Health Personnel in Canada, 1992* (Health and Welfare Canada, Catalogue H1-9/1-1992) Ottawa: Minister of Supply and Services, 1992: Table 7.2.

22 Locker D, Leake JL, Lee J, et al. Utilization of dental services by older adults in four Ontario communities. *Journal of the Canadian Dental Association* 1991; 57(11): 879-86.

23 Hand JS, Kohout FJ, Cunningham MA. Incidence of edentulism in a non-institutionalized elderly population. *Gerodontics* 1988; 4: 13-7.

24 Kuc IM, Hargreaves JA, Thompson GW, et al. Dental health status and treatment needs of elderly residents of Edmonton, Alberta. *Journal of the Canadian Dental Association* 1990; 56(6): 521-5.

25 World Health Organization. *Fluorides and oral health. Report of a WHO Expert Committee on Oral Health Status and Fluoride Use* (Technical Report Series No. 846) Geneva: World Health Organization, 1994.

Appendix

Table A
Distribution of household population aged 15 or older, by selected socioeconomic characteristics, Canada excluding territories, 1996/97

	Sample size	Estimated population	
		'000	%
Both sexes	**70,884**	**23,444**	**100**
Men	32,981	11,519	49
Women	37,903	11,925	51
Age			
15-24	9,602	3,983	17
25-34	14,216	4,472	19
35-44	14,684	5,238	22
45-54	10,715	3,771	16
55-64	8,304	2,565	11
65+	13,363	3,416	15
Province			
Newfoundland	827	449	2
Prince Edward Island	808	107	1
Nova Scotia	852	738	3
New Brunswick	902	607	3
Québec	2,412	5,862	25
Ontario	37,716	8,879	38
Manitoba	11,417	857	4
Saskatchewan	904	752	3
Alberta	13,683	2,121	9
British Columbia	1,363	3,072	13
Residence			
Rural	14,999	4,047	17
Urban	55,842	19,388	83
Missing	43	10	- -
Household income			
Lowest/Lower-middle	9,528	3,051	13
Middle	16,668	5,865	25
Upper-middle	21,066	7,655	33
Highest	8,348	2,966	13
Missing	15,274	3,906	17
Educational attainment			
Less than secondary graduation	19,634	6,377	27
Secondary graduation	12,537	3,909	17
Some postsecondary	14,679	5,398	23
Postsecondary graduation	23,304	7,595	32
Not applicable/Not stated	730	165	1
Employment status			
Currently working	40,743	13,816	59
Not currently working	24,412	8,234	35
Worked in past 12 months, current work status unknown	378	127	1
Missing	5,351	1,268	5
Dental insurance status			
Insured	38,222	12,318	53
Not insured	30,230	10,318	44
Missing	2,432	808	3
Dental visit in last year			
Yes	41,400	13,870	59
No	27,638	8,972	38
Missing	1,846	602	3

***Data source**: 1996/97 National Population Health Survey, cross-sectional sample, Health file*
- - Amount too small to provide reliable estimate

Table B
Unadjusted odds ratios for dental insurance coverage, household population aged 15 or older, Canada excluding territories, 1996/97

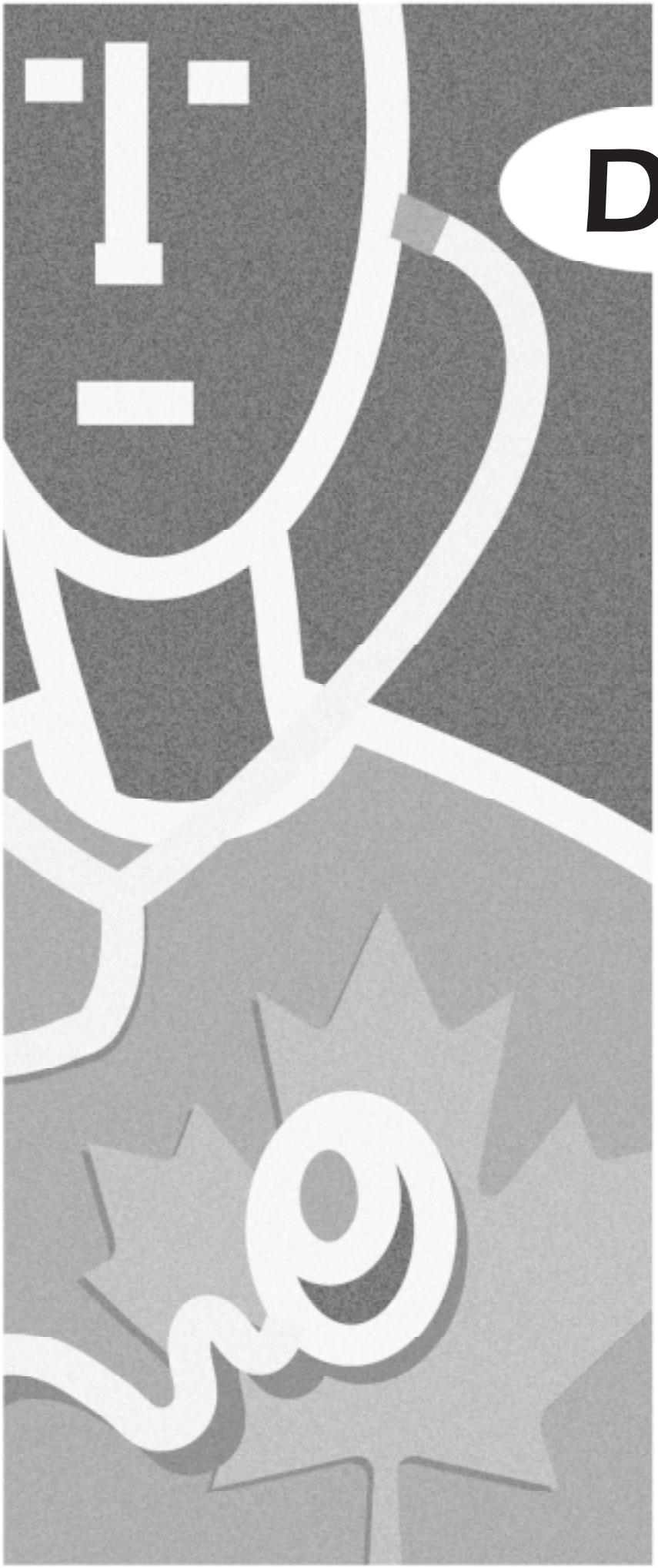
	Unadjusted odds ratio	95% confidence interval
Both sexes		
Men	1.09*	1.03, 1.16
Women†	1.00	...
Age group		
15-24	4.59*	4.06, 5.20
25-34	4.92*	4.41, 5.50
35-44	6.30*	5.66, 7.01
45-54	5.62*	5.03, 6.27
55-64	2.92*	2.57, 3.32
65 or older†	1.00	...
Province		
Newfoundland†	1.00	...
Prince Edward Island	1.33*	1.05, 1.69
Nova Scotia	1.37*	1.09, 1.74
New Brunswick	1.57*	1.25, 1.97
Québec	0.94	0.78, 1.14
Ontario	2.34*	2.00, 2.75
Manitoba	1.90*	1.61, 2.25
Saskatchewan	1.38*	1.11, 1.71
Alberta	2.28*	1.93, 2.69
British Columbia	2.02*	1.64, 2.49
Residence		
Rural†	1.00	...
Urban	1.40*	1.28, 1.53
Household income		
Lowest/Lower-middle†	1.00	...
Middle	2.44*	2.17, 2.75
Upper-middle	7.09*	6.25, 8.02
Highest	10.74*	9.12, 12.64
Educational attainment		
Less than secondary graduation†	1.00	...
Secondary graduation	1.74*	1.56, 1.92
Some postsecondary	1.78*	1.62, 1.96
Postsecondary graduation	2.41*	2.20, 2.64
Employment status		
Currently working	2.74*	2.54, 2.95
Not currently working†‡	1.00	...
Worked in last 12 months, current work status unknown	1.60	0.98, 2.59

***Data source:** 1996/97 National Population Health Survey, cross-sectional sample, Health file*
† Reference category, for which odds ratio is always 1.0
‡ Not currently working, but had a job, or did not work during last 12 months
** $p < 0.05$*
··· Not applicable

Table C
Unadjusted odds ratios for dental visit in past year, household population aged 15 or older, Canada excluding territories, 1996/97

	Unadjusted odds ratio	95% confidence interval
Both sexes		
Men†	1.00	...
Women	1.18*	1.11, 1.26
Age group		
15-24	2.79*	2.50, 3.11
25-34	2.18*	1.94, 2.44
35-44	2.70*	2.42, 3.01
45-54	2.40*	2.15, 2.67
55-64	1.46*	1.29, 1.65
65 or older†	1.00	...
Province		
Newfoundland†	1.00	...
Prince Edward Island	1.85*	1.49, 2.28
Nova Scotia	1.76*	1.38, 2.24
New Brunswick	1.42*	1.13, 1.78
Québec	1.51*	1.24, 1.84
Ontario	3.28*	2.77, 3.88
Manitoba	1.99*	1.66, 2.38
Saskatchewan	1.19	0.94, 1.52
Alberta	1.94*	1.63, 2.30
British Columbia	2.43*	1.96, 3.02
Residence		
Rural†	1.00	...
Urban	1.39*	1.27, 1.52
Household income		
Lowest/Lower-middle	1.00	...
Middle	1.59*	1.41, 1.80
Upper-middle	2.89*	2.58, 3.23
Highest	5.44*	4.64, 6.39
Educational attainment		
Less than secondary graduation†	1.00	...
Secondary graduation	1.60*	1.45, 1.77
Some postsecondary	1.88*	1.72, 2.06
Postsecondary graduation	2.59*	2.33, 2.88
Employment status		
Currently working	1.63*	1.52, 1.75
Not currently working‡	1.00	...
Worked in last 12 months, current work status unknown	1.40	0.89, 2.20
Dental insurance status		
Insured	3.70*	3.44, 3.98
Not insured	1.00	...

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
† Reference category, for which odds ratio is 1.0
‡ Not currently working, but had a job, or did notwork during last 12 months
** $p < 0.05$*
··· Not applicable



Data Releases

Synopses of recent health information produced by Statistics Canada

National Population Health Survey, Cycle 2 – Residents of health care institutions, 1996/97

According to data from the 1996/97 National Population Health Survey (NPHS), the number of persons aged 65 or older living in health care institutions (185,000) was virtually unchanged from 1994/95 (186,000). However, one-half (51%) of seniors living in these facilities were recent arrivals, meaning they had moved to an institution sometime between 1994/95 and 1996/97.

More than a third (37%) of these newer residents reported their previous residence as a hospital, seniors' residence or nursing/convalescent home. However, the majority (59%) had lived in a private household before moving to an institution. In fact, results from the household component of the NPHS revealed that, between 1994/95 and 1996/97, 1.7% of the household population aged 65 or older was institutionalized for long-term care. Over half of these movers to health care facilities (54%) were aged 80 or older.

The data suggest that certain chronic health conditions, which necessitate greater levels of daily care, are more likely to result in a transition from a private household to an institution. Nearly two-thirds (65%) of household seniors who had moved to health care facilities by 1996/97 had experienced the onset of incontinence, stroke, or Alzheimer's disease or other dementia since 1994/95. Only 8% of seniors who remained in private households reported a new diagnosis of these chronic conditions in 1996/97.

The change in the make-up of the institutional population aged 65 or older was also a result of the high mortality rate among senior residents between 1994/95 and 1996/97. After adjusting for age and sex differences between institutional and private household populations, the proportion of senior institutional residents who died in that two-year period (29%) was almost four times that for seniors in private households (8%). The prevalence of multiple health problems among elderly residents of health care facilities accounts for some of this difference.

This information, which is based on the second cycle of the health institutions component of the NPHS, was originally released in the Statistics Canada publication *The Daily* on June 25, 1999. For more information, or to enquire about the concepts, methods or data quality of this release, contact Lucie Cossette (613-951-8933; fax: 613-951-4198; cossluc@statcan.ca), Health Statistics Division. To request custom tabulations, contact the Client Custom Services Unit (613-951-1746).

Births, 1997

In 1997, 348,598 babies were born in Canada, down 4.8% from the previous year—the largest annual decline in the 1987 to 1997 period. The total fertility rate also fell to a record low.

Although women in their twenties continued to account for the majority of first-born babies, first-time mothers are getting older. In 1997, almost one-third (31%) of first births were to mothers aged 30 or older, compared with 19% a decade earlier. The percentage of births to first-time mothers aged 30 or older ranged from approximately 20% in Saskatchewan and the Northwest Territories to more than 35% in Ontario and British Columbia. Ten years earlier, the percentages had been lower in all provinces and territories, ranging from 9% to 26%.

Throughout the 1987-to-1997 period, older mothers accounted for an increasing proportion of all births. In 1997, 44% of live births were to women in the 30-or-older age group, compared with 31% in 1987. By contrast, the proportion of all live births to women in their twenties slipped from 63% to 50%.

Nationally, teenagers accounted for 6% of births throughout the decade. The proportion was 5% in Ontario, Québec and British Columbia in 1997, and reached highs of 11% in Saskatchewan and 17% in the Northwest Territories. Territorial estimates should be viewed cautiously, however, given the small populations.

Despite an upturn in the early 1990s, by 1997, the fertility rate was 1,552 live births per 1,000 women aged 15 to 49, less than half the peak reached in 1959 (3,935). The Northwest Territories had the highest fertility rate in 1997; Newfoundland, the

lowest. Women aged 25 to 29 had the highest fertility rate: 103.9 live births per 1,000. Those aged 30 to 34 followed, with 84.4 live births per 1,000. In 1997, the fertility rate for all age groups under 30 was lower than it had been in 1987.

Infant mortality (the death of children under one year of age) dropped to 5.5 deaths per 1,000 live births in 1997, compared with 7.3 per 1,000 in 1987. The rate for girls remained lower than that for boys: 5.0 deaths per 1,000 live births compared with 6.0. Prince Edward Island and Nova Scotia recorded the lowest infant mortality rates in 1997, with 4.4 deaths per 1,000 live births. The rate in Québec, which had dropped to a record low in 1996, rose to 5.6.

These data were released in *The Daily* on June 16, 1999. For more information, or to enquire about the concepts, methods and data quality of this release, contact Patricia Tully (613-951-1759) or Doreen Duchesne (613-951-6379), Health Statistics Division. To obtain data, contact Client Custom Services (613-951-1746).

Deaths, 1997

In 1997, the life expectancy of both men and women reached record highs as mortality rates for most leading causes of deaths declined. Life expectancy at birth, which is a key indicator of a population's health status, was 81.4 years for women and 75.8 years for men, gains of 0.1 and 0.3 years, respectively, over 1996.

While women born in 1997 could still expect to outlive men, the gap in life expectancy at birth between the sexes has been narrowing in the last two decades. It dropped to 5.6 years in 1997, down from a peak of 7.5 years in 1978.

Life expectancy for both sexes combined was highest in Prince Edward Island, British Columbia, Ontario and Alberta (about 79 years), and shortest in the two territories and Newfoundland. Gains were relatively strong in Alberta, Ontario, British Columbia, Saskatchewan and the Northwest Territories (from 0.3 to 0.5 years). Prince Edward Island recorded the strongest increase (2.2 years), but this reflects a recovery from an unusually high number of deaths in 1996. Annual variations in this province, along with the two territories, should be interpreted with caution given the small number of deaths involved. Life expectancy declined in Newfoundland, the Yukon and Québec.

The number of deaths continues to rise each year as the population increases and ages. A total of 215,669 individuals died in 1997—an average of 591 people each day. The total number of deaths in Canada increased 1.3% over 1996. Deaths among men rose 0.5% to 111,985; the increase for women was 2.2%, to 103,684.

For men, the age-standardized mortality rate fell from 860.6 deaths for every 100,000 population in 1996 to 844.0 in 1997. (Rates are standardized to remove the effect of the growing number of elderly people.) Mortality rates among men declined for all major causes of death: cancer; heart, cerebrovascular and chronic obstructive pulmonary diseases; and unintentional injuries.

The picture for women was even more favourable. The age-standardized mortality rate for women dropped from 526.6 to 521.6 deaths for every 100,000 population. Lung cancer deaths, which had been rising for women in recent decades, declined from 33.6 to 32.3 per 100,000. Mortality rates for women were also down for all of the other major causes of death, with the exception of a slight increase for chronic obstructive pulmonary diseases.

The majority of deaths were caused by some form of cancer or heart disease, each of which accounted for over one-quarter (27%) of the total. An additional 16% of deaths were attributed to cerebrovascular diseases (mainly stroke), chronic obstructive pulmonary diseases (including emphysema, chronic bronchitis and asthma) and unintentional injuries combined. Lung, colorectal, breast and prostate malignancies accounted for 51% of all cancer deaths. Acute myocardial infarction (heart attack) represented 38% of mortality due to heart diseases.

Deaths related to the human immunodeficiency virus (HIV) plunged to their lowest level in 10 years after soaring through the late 1980s and early 1990s. In 1997, 626 individuals died of HIV, down 52% over the previous year. This follows a 26% decline

between 1995 and 1996, which was the first significant drop in HIV-related mortality reported in Canada.

The number of suicides also declined substantially. A total of 3,681 people took their own lives in 1997, down 6.6% from the previous year. Suicides decreased in Ontario, Québec, Alberta, New Brunswick, Nova Scotia and the Yukon. Although Québec recorded a 6.7% decline, 37% of all suicides in Canada occurred in this province. Ontario accounted for one-quarter of the national total.

The age-standardized suicide rate increased in four provinces: Manitoba, Prince Edward Island, Newfoundland and British Columbia. Québec's rate fell from 19.8 deaths for every 100,000 population to 18.1, yet remained the highest among the provinces. Alberta followed at 14.3 deaths per 100,000 population. The suicide rate increased substantially in the Northwest Territories, but this should be interpreted with caution, as it is based on relatively few deaths.

These data were released on May 13, 1999, in the Statistics Canada publication *The Daily*. For more information, or to enquire about the concepts, methods or data quality of this release, contact Doreen Duchesne (613-951-6379) or Russell Wilkins (613-951-5305), Health Statistics Division. To order standard or custom tabulations, contact Client Custom Services (613-951-1746).

Divorces, 1997

The number of marriages ending in divorce fell for the third straight year in 1997. A total of 67,408 couples divorced in 1997, down 5.8% from the previous year and the lowest number since 1985, just before amendments to the *Divorce Act* came into effect.

Several factors have likely contributed to the decline in divorces in recent years, among them a drop in the number of marriages between 1989 (190,640) and 1996 (156,691). Because fewer people are marrying, the pool of persons at risk of divorce is smaller than it would otherwise have been. In addition, many couples settle a marriage breakdown through separation agreements that need not be followed by a legal divorce unless, for example, one of the parties decides to remarry.

Between 1996 and 1997, the largest percentage decline in divorces occurred in Newfoundland, where 822 couples divorced (-22.5%), and in British Columbia where 9,692 couples divorced (-11.1%). These declines followed substantial increases in these provinces between 1995 and 1996.

The number of divorces also fell in Ontario and Québec, but the pace is slowing. In Ontario, 23,629 couples obtained a divorce in 1997, down 5.6% from the previous year. This contrasts with a 14.7% decline in 1996. In Québec, 17,478 couples officially ended their marriage in 1997 (-3.3%), a much smaller drop than the 10.2% decline in 1996.

The number of divorces increased slightly in two provinces. In Prince Edward Island, 243 couples obtained a divorce in 1997, up 2.5% from 1996, and in Manitoba, divorces rose a marginal 0.8% to 2,625.

Crude divorce rates are generally calculated as the number of divorces for every 100,000 population. The divorce rate has declined in each of the past four years. In 1997, there were 222.6 divorces for every 100,000 population in Canada, down from 270.2 in 1993. The highest divorce rates in 1997 were in the Yukon (319.3), Alberta (252.4) and British Columbia (246.4); the lowest were in the Northwest Territories (117.0), Newfoundland (145.8) and Prince Edward Island (177.1)

Divorce rates by years of marriage can be used to estimate marriage stability. Based on 1997 rates, the percentage of marriages expected to end in divorce within 30 years was 34.8%, down from 36.9% based on 1996 rates.

On average, marriages ending in divorce have been lasting longer. The average duration has increased from 12.3 years in 1993 to 13.3 years in 1997. These calculations do not take into account deaths or unofficial separations, for which there are no data.

In 1997, men were on average 41.4 years old at the time of divorce, compared with 38.8 for women.

Almost half of the total number of divorces granted in 1997 (39,204) involved a custody order

for dependent children. Custody was granted to the wife in 61.2% of these cases, far ahead of joint custody to both parents (27.6%) or custody to the husband (11.0%). However, in many cases not involving a custody order, residential arrangements are negotiated by parents outside of formal court proceedings.

These data were released on May 18, 1999 in the Statistics Canada publication *The Daily*. The standard tables *Divorces in Canada, 1996 and 1997* (84F0213XPB, $20) are now available. To order this product or custom tabulations, call Client Custom Services (613-951-1746), Health Statistics Division. For more information, or to enquire about the concepts, methods, and data quality of this release, contact Claude Grenier (613-951-8388), Health Statistics Division.

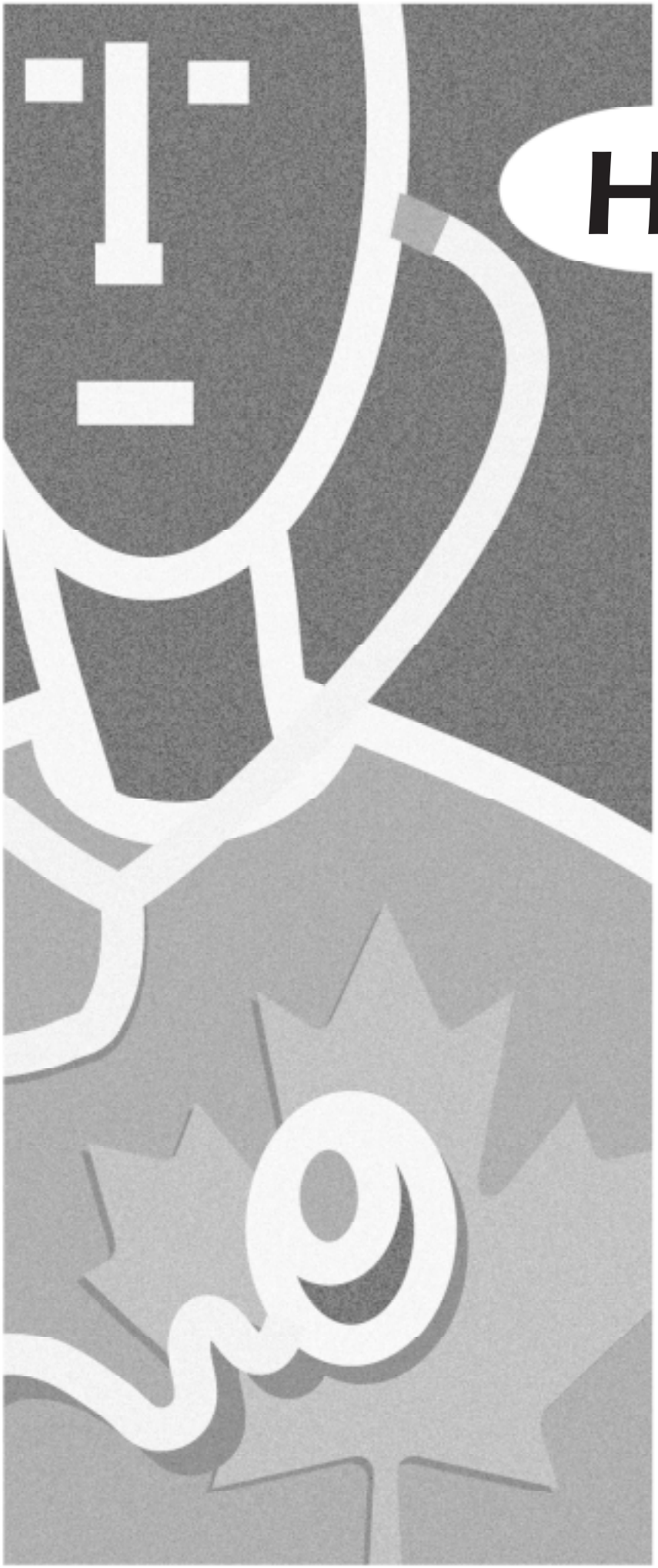
Postcensal Population Estimates

Each issue of *Health Reports* includes current quarterly population estimates. Estimates for July 1, 1997 are shown on the following page.

Preliminary postcensal population estimates, by sex and age group, Canada, provinces and territories, July 1, 1997

	Canada	Nfld.	P.E.I.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	Alta.	B.C.	Yukon	N.W.T.
							'000						
Both sexes	**30,286.6**	**563.6**	**137.2**	**947.9**	**762.0**	**7,419.9**	**11,407.7**	**1,145.2**	**1,023.5**	**2,847.0**	**3,933.3**	**31.6**	**67.5**
<1	363.2	5.6	1.7	10.3	8.1	82.9	139.2	15.5	13.0	38.1	46.9	0.5	1.5
1-4	1,552.6	24.3	7.1	44.1	35.4	362.2	594.4	65.2	56.3	159.3	196.5	1.9	5.9
5-9	2,049.4	35.4	9.9	63.0	48.8	474.0	777.5	83.5	79.3	214.6	253.1	2.4	8.0
10-14	2,027.1	41.2	10.1	64.1	51.5	456.8	758.5	81.5	81.8	215.7	257.2	2.4	6.4
15-19	2,024.1	43.2	10.0	63.4	52.3	502.0	731.8	78.7	77.3	203.3	254.5	2.3	5.3
20-24	2,034.5	43.7	9.7	65.1	55.3	485.5	750.8	79.7	70.5	202.6	264.0	2.2	5.4
25-29	2,203.0	44.3	9.7	68.3	57.0	503.9	851.3	81.0	64.0	218.5	296.2	2.4	6.3
30-34	2,564.4	45.7	10.7	77.9	62.5	619.3	1,003.7	90.0	73.8	243.8	327.4	3.1	6.5
35-39	2,706.0	47.5	11.0	82.9	64.6	674.3	1,024.0	95.2	82.7	267.1	347.3	3.3	5.9
40-44	2,465.9	47.0	10.2	76.3	62.2	626.5	905.8	86.9	78.0	242.2	323.2	2.9	4.8
45-49	2,183.8	43.1	9.6	69.4	57.2	560.0	809.3	76.3	63.8	195.1	293.3	2.8	3.8
50-54	1,794.1	34.8	8.0	57.7	45.6	478.7	666.0	62.7	51.0	151.4	233.7	2.0	2.5
55-59	1,382.6	25.2	6.1	44.3	34.6	365.6	520.5	48.9	42.3	113.9	178.6	1.0	1.8
60-64	1,210.0	21.0	5.6	38.6	29.5	310.9	463.2	43.8	40.0	98.6	156.5	0.8	1.4
65-69	1,141.3	18.7	5.0	35.0	28.5	294.0	438.0	42.5	39.5	89.1	149.3	0.8	1.0
70-74	986.1	15.9	4.4	30.4	25.0	246.2	381.9	39.5	36.6	73.4	131.9	0.5	0.6
75-79	743.0	13.0	3.7	26.0	20.3	177.8	278.6	32.6	31.2	55.9	103.4	0.2	0.2
80-84	476.6	8.1	2.6	17.3	13.1	111.1	174.3	22.8	22.8	35.9	68.4	0.1	0.2
85-89	251.6	4.1	1.4	9.2	7.1	58.7	92.1	12.2	12.9	18.5	35.3	0.0	0.1
90+	127.1	1.8	0.8	4.7	3.5	29.6	46.8	6.6	6.7	10.0	16.7	0.0	0.1
Males	**14,999.7**	**281.3**	**67.8**	**466.7**	**376.9**	**3,657.2**	**5,636.3**	**567.8**	**508.3**	**1,432.5**	**1,953.6**	**16.3**	**35.0**
<1	186.0	2.8	0.9	5.2	4.2	42.5	71.4	7.9	6.5	19.5	24.2	0.2	0.7
1-4	795.8	12.5	3.7	22.8	18.1	185.2	304.5	33.4	28.6	81.8	101.3	0.9	3.0
5-9	1,049.5	18.2	5.1	32.4	24.9	242.7	398.3	42.9	40.4	109.9	129.2	1.3	4.2
10-14	1,035.4	21.0	5.2	32.6	26.2	232.8	388.2	42.0	41.4	110.4	131.0	1.2	3.3
15-19	1,037.3	21.7	4.9	31.9	26.9	257.2	375.9	39.9	40.1	104.1	130.8	1.2	2.7
20-24	1,032.1	22.3	5.0	33.1	28.1	247.2	380.2	40.8	36.0	103.4	132.2	1.1	2.7
25-29	1,110.4	22.7	5.0	34.9	29.0	256.6	425.8	41.2	32.0	110.8	148.0	1.2	3.3
30-34	1,298.2	22.7	5.2	39.5	31.6	316.0	507.0	45.7	36.7	124.4	164.5	1.6	3.4
35-39	1,364.7	23.7	5.4	40.9	32.3	341.0	516.6	48.6	41.8	136.1	173.6	1.6	3.0
40-44	1,231.0	23.3	5.1	37.5	30.8	313.7	449.1	43.6	40.1	123.4	160.5	1.4	2.5
45-49	1,096.0	21.7	4.9	34.6	28.9	280.4	402.7	38.5	32.8	99.5	148.4	1.4	2.1
50-54	899.1	17.7	4.1	29.2	23.2	237.5	332.0	31.6	25.7	77.1	118.4	1.1	1.4
55-59	687.3	12.9	3.1	22.1	17.4	180.0	257.5	24.1	20.8	58.2	89.6	0.7	1.0
60-64	593.7	10.6	2.7	19.0	14.5	149.3	226.5	21.7	19.9	49.3	79.1	0.4	0.7
65-69	544.9	9.2	2.5	16.4	13.3	135.8	209.6	20.1	19.2	43.7	74.2	0.5	0.5
70-74	439.0	7.5	2.0	13.4	11.0	106.2	169.5	17.6	16.9	33.9	60.5	0.3	0.3
75-79	305.6	5.7	1.5	10.6	8.5	69.7	114.9	13.4	13.3	23.8	44.1	0.1	0.1
80-84	177.9	3.2	0.9	6.5	5.0	38.7	65.2	8.7	9.1	13.8	26.8	0.0	0.1
85-89	81.9	1.4	0.5	3.0	2.3	17.5	29.6	4.2	4.7	6.4	12.3	0.0	0.1
90+	33.7	0.5	0.2	1.1	0.9	7.2	11.8	1.8	2.1	3.1	5.0	0.0	0.0
Females	**15,286.9**	**282.3**	**69.4**	**481.2**	**385.1**	**3,762.7**	**5,771.4**	**577.4**	**515.2**	**1,414.5**	**1,979.7**	**15.3**	**32.5**
<1	177.2	2.8	0.8	5.1	3.9	40.5	67.8	7.6	6.5	18.6	22.6	0.2	0.7
1-4	756.8	11.8	3.4	21.3	17.3	177.0	289.9	31.9	27.7	77.5	95.2	1.0	2.8
5-9	999.9	17.2	4.8	30.5	23.9	231.2	379.2	40.6	38.8	104.7	123.9	1.1	3.9
10-14	991.8	20.3	4.9	31.5	25.3	223.9	370.3	39.5	40.4	105.3	126.1	1.2	3.1
15-19	986.8	21.5	5.0	31.5	25.4	244.9	355.9	38.8	37.2	99.3	123.8	1.1	2.6
20-24	1,002.4	21.4	4.7	32.1	27.2	238.2	370.6	38.9	34.5	99.2	131.8	1.1	2.7
25-29	1,092.6	21.6	4.8	33.5	28.0	247.3	425.5	39.8	32.0	107.7	148.2	1.2	3.1
30-34	1,266.2	23.0	5.5	38.5	30.9	303.2	496.7	44.3	37.1	119.4	162.9	1.5	3.1
35-39	1,341.3	23.8	5.6	42.0	32.3	333.4	507.4	46.6	40.9	131.0	173.7	1.7	2.9
40-44	1,234.9	23.6	5.0	38.8	31.4	312.7	456.6	43.4	38.0	118.8	162.7	1.5	2.3
45-49	1,087.8	21.5	4.7	34.7	28.3	279.7	406.6	37.8	31.0	95.6	144.9	1.4	1.6
50-54	895.0	17.1	3.9	28.6	22.4	241.2	333.9	31.1	25.2	74.3	115.3	0.9	1.1
55-59	695.3	12.3	3.0	22.2	17.2	185.6	263.0	24.8	21.5	55.7	89.0	0.4	0.8
60-64	616.2	10.4	2.9	19.6	15.0	161.6	236.7	22.1	20.1	49.3	77.4	0.4	0.7
65-69	596.4	9.5	2.5	18.5	15.2	158.2	228.4	22.3	20.3	45.5	75.2	0.3	0.5
70-74	547.1	8.4	2.3	17.0	14.0	140.0	212.3	21.9	19.7	39.5	71.4	0.2	0.3
75-79	437.4	7.3	2.2	15.3	11.8	108.1	163.7	19.2	17.9	32.1	59.4	0.1	0.2
80-84	298.7	4.9	1.7	10.9	8.1	72.4	109.2	14.1	13.8	22.0	41.5	0.1	0.1
85-89	169.7	2.6	1.0	6.2	4.8	41.2	62.5	8.0	8.2	12.1	23.0	0.0	0.0
90+	93.4	1.3	0.6	3.6	2.6	22.3	35.0	4.8	4.6	6.9	11.7	0.0	0.0

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



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