Catalogue no. 82-003-XIE

Health Reports

Vol. 13 No. 4

- Shift work
- Seniors' independence
- Disability-free life expectancy

Statistics Canada Statistique Canada

Canada

How to obtain more information

Specific inquiries about this product and related statistics or services should be directed to: Health Statistics Division, Statistics Canada, Ottawa, Ontario, Canada, K1A 0T6 (telephone: (613) 951-1746).

For information on the wide range of data available from Statistics Canada, you can contact us by calling one of our toll-free numbers. You can also contact us by e-mail or by visiting our Web site.

National inquiries line	**1 800 263-1136**
National telecommunications device for the hearing impaired	**1 800 363-7629**
Depository Services Program inquiries	**1 800 700-1033**
Fax line for Depository Services Program	**1 800 889-9734**
E-mail inquiries	**infostats@statcan.ca**
Web site	**www.statcan.ca**

Ordering and subscription information

This product, Catalogue no. 82-003-XPE, is published quarterly as a standard printed publication at a price of CDN $20.00 per issue and CDN $58.00 for a one-year subscription. The following additional shipping charges apply for delivery outside Canada:

	Single issue	Annual subscription
United States	CDN $ 6.00	CDN $24.00
Other countries	CDN $ 10.00	CDN $40.00

This product is also available in electronic format on the Statistics Canada Internet site as Catalogue no. 82-003-XIE at a price of CDN $15.00 per issue and CDN $44.00 for a one-year subscription. To obtain single issues or to subscribe, visit our Web site at **www.statcan.ca**, and select Products and Services.

All prices exclude sales taxes.

The printed version of this publication can be ordered by

- Phone (Canada and United States) **1 800 267-6677**
- Fax (Canada and United States) **1 877 287-4369**
- E-mail **order@statcan.ca**
- Mail Statistics Canada
  Dissemination Division
  Circulation Management
  120 Parkdale Avenue
  Ottawa, Ontario K1A 0T6
- And, in person at the Statistics Canada Reference Centre nearest you, or from authorized agents and bookstores.

When notifying us of a change in your address, please provide both old and new addresses.

Standards of service to the public

Statistics Canada is committed to serving its clients in a prompt, reliable and courteous manner and in the official language of their choice. To this end, the Agency has developed standards of service that its employees observe in serving its clients. To obtain a copy of these service standards, please contact Statistics Canada toll free at 1 800 263-1136.

Statistics Canada
Health Statistics Division

Health Reports

Volume 13, Number 4

Published by authority of the Minister responsible for Statistics Canada

July 2002

Catalogue no. 82-003-XPE, Vol. 13, No. 4
ISSN 0840-6529

Catalogue no. 82-003-XIE, Vol. 13, No. 4
ISSN 1209-1367

Frequency: Quarterly

Ottawa

Note of Appreciation

Canada owes the success of its statistical system to a long-standing partnership between Statistics Canada, the citizens of Canada, its businesses, governments and other institutions. Accurate and timely statistical information could not be produced without their continued cooperation and goodwill.

SYMBOLS

The following standard symbols are used in Statistics Canada publications:

.	not available for any reference period
..	not available for specific reference period
...	not applicable
p	preliminary figures
r	revised figures
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
E	use with caution
F	too unreliable to be published

The paper used in this publication meets the minimum requirements of American National Standard for Information Sciences - Permanence of Paper for Printed Library Materials, ANSI Z39.48 - 1984.
♾

About Health Reports

Health Reports is a quarterly journal produced by the Health Statistics Division at Statistics Canada. It is designed for a broad audience that includes health professionals, researchers, policy-makers, educators, and students. Its mission is to provide high quality, relevant, and comprehensive information on the health status of the population and on the health care system. The journal publishes articles of wide interest that contain original and timely analyses of health and vital statistics data. The sources of data are typically national or provincial/territorial administrative data bases or surveys.

Health Reports contains *Research Articles* and *Data Releases*. *Research Articles* present in-depth analysis and undergo anonymous peer review. They are indexed in Index Medicus and MEDLINE. *Data Releases* are synopses of recent health information produced by the Health Statistics Division.

For information on subscribing, see *How to Order*. For other information, contact the Editors, **Health Reports**, Health Statistics Division, Statistics Canada, 18th Floor, R.H. Coats Building, Ottawa, Ontario, Canada K1A 0T6. Telephone: (613) 951-7025. E-mail: healthreports@statcan.ca. Fax: (613) 951-0792.

Peer Reviewers

The clinical, methodological and subject matter specialists listed here have reviewed articles submitted for Volume 13, Issues 1 through 4, of *Health Reports*. The editors thank them for their valuable contribution of expertise and time.

Gordon J.M. Bargh
Susan Bronskill
Claire C. Caruso
Jiajian Chen
Sheldon Cohen
Donald Cole
Giovanni Costa
Margaret de Groh
Cam Donaldson
Johane Dufour
Geoffrey Evans
Murray M. Finkelstein
Ken Fowler
Ellen M. Gee
Lynn A. Gloeckler Ries
Katherine Gray-Donald
Paul Grootendorst
Betty Havens
Andrea D. Hill
Robert Hilsden
Ellen L. Idler
Beth Junkins
Jessica A. Kelley-Moore
Merrijoy Kelner
George Kephart
Merril L. Knudtson
Nancy Krieger
Audrey Laporte
Renée Lawrence
Steven Lewis
Mary-Jo Makarchuk
Doug Manuel
Alexandra L.C. Martiniuk
Ellen Meara
Brian Mishara
Cam Mustard
Stephen Newman
Tom Noseworthy
Robert Pampalon
Dave Paton
Debra Reid
Jean-Marie Robine
Roger R. Rosa
Isaac Sakinofsky
Allene J. Scott
Cathy Sherbourne
M.P. Singh
Mark Speechley
William Strawbridge
Sally Thorne
Michel Tousignant
Anne-Marie Ugnat
Marja Verhoef
Terrance J. Wade
Deanna L. Williamson
Andrew Wister

Requests to reprint

Electronic version

Health Reports is also published as an electronic product in PDF format. Single issues may be ordered (using Visa or MasterCard) from Statistics Canada's Internet site, downloaded onto your desktop and accessed with Adobe Acrobat Reader. To order a recent issue of *Health Reports*, visit our site at http://www.statcan.ca. Select "English" from the home page, then "Our products and services" from the next page. Select "Publications for sale ($)" and then "Health," where you will find *Health Reports* (Catalogue 82-003-XIE).

Citation recommendation

Health Reports has a unique Statistics Canada catalogue number: 82-003-XPE for the paper version and 82-003-XIE for the English electronic version. This number facilitates storing and retrieving the journal in libraries, either on the shelf or electronically. Thus, we request that, when citing a *Health Reports* article in other published material, authors include our catalogue number in the citation.

Example:

Parsons GF, Gentleman JF, Johnston KW. Gender differences in abdominal aortic aneurysm surgery. *Health Reports* (Statistics Canada, Catalogue 82-003) 1997; 9(1): 9-18.

In This Issue

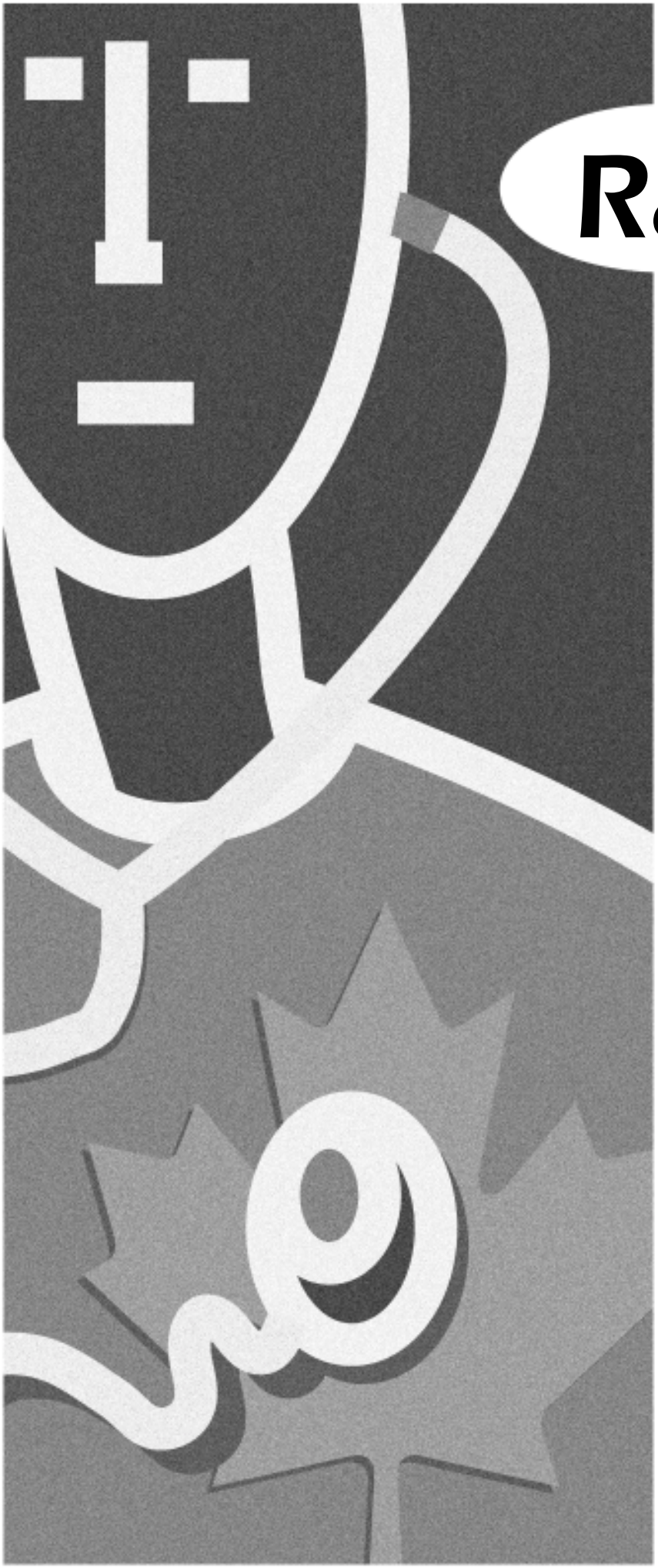
Research Articles

Data Releases

Subject Index

How to Order

Health Statistics Division's products and services, including prices and ordering information



Research Articles

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

Shift work and health

Margot Shields

Abstract

Objectives

This article describes the characteristics of shift workers and compares stress factors and health behaviours of shift and regular daytime workers. Based on an analysis of people followed over four years, associations between the incidence of chronic conditions and changes in psychological distress levels are explored in relation to working shift.

Data sources

Data are from the 2000/01 Canadian Community Health Survey, the longitudinal (1994/95, 1996/97 and 1998/99) and cross-sectional (1994/95) components of the National Population Health Survey, and the Survey of Work Arrangements (1991 and 1995).

Analytical techniques

Cross-tabulations were used to profile shift workers and to compare some of their health behaviours and sources of stress with those of regular daytime workers. Multivariate analyses were used to examine associations between shift work and the incidence of chronic conditions and changes in psychological distress levels over four years, controlling for other potential confounders.

Main results

Men who worked an evening, rotating or irregular shift had increased odds of reporting having been diagnosed with a chronic condition over a four-year period. For both sexes, an evening shift was associated with increases in psychological distress levels over two years.

Key words

work schedule tolerance, occupational health, job strain, health behaviour, stress, health status

Author

Margot Shields (613-951-4177; margot.shields@statcan.ca) is with the Health Statistics Division at Statistics Canada, Ottawa, Ontario, K1A 0T6.

At any given time, approximately 30% of employed Canadians work shift; that is, non-standard hours. For most of them, shift work is not a choice, but a job requirement. Our society, which has long needed around-the-clock provision of medical, transportation and protection services, now also demands more flexible access to many commercial, industrial and financial services. While shift work may be critical to the economy, evidence indicates that it can take a physical and emotional toll on workers.[1,2]

The most common health complaint of shift workers is lack of sleep,[3-9] but shift work has also been associated with cardiovascular disease,[10-16] hypertension[17] and gastrointestinal disorders,[8,18,19] and for women, with reproductive health problems[20,21] and breast cancer.[22,23] Shift work may exacerbate conditions such as asthma, diabetes and epilepsy.[24] Mental health disorders such as anxiety and depression have also been linked to shift work.[25-30]

Researchers have proposed three potentially interrelated pathways that may explain the association between shift work and health problems: disruption of circadian rhythms, adoption or worsening of unhealthy behaviour, and stress.[10,13]

Data sources

Canadian Community Health Survey

The 2000/01 prevalence rates for non-standard work schedules in this article are based on cycle 1.1 of Statistics Canada's Canadian Community Health Survey (CCHS), which collects information at the health region level.[31] Data collection for cycle 1.1 began in September 2000 and was conducted over 14 months. The CCHS covers the household population aged 12 or older in all provinces and territories, except persons living on Indian reserves, on Canadian Forces Bases, and in some remote areas.

The CCHS uses the area frame designed for the Labour Force Survey as its primary sampling frame. A multistage stratified cluster design was used to sample dwellings within the area frame. A list of the dwellings was prepared, and a sample of dwellings was selected from the list. The majority (83%) of the sampled households came from the area frame, and face-to-face interviews were held with respondents randomly selected from households in this frame. In some health regions, a random digit dialing (RDD) and/or list frame of telephone numbers was also used. Respondents in the telephone frames, who accounted for the remaining 17% of the targeted sample, were interviewed by telephone.

In approximately 82% of the households selected from the area frame, one person was randomly selected; two people were randomly chosen in the remaining households. For households selected from the telephone frames, one person was randomly chosen. The response rate was 84.7%. The responding sample size for cycle 1.1 was 131,535. A total of 6.3% of interviews were obtained by proxy.

The CCHS sample used to produce prevalence rates for this article consists of 24,364 men and 22,398 women aged 18 to 54 living in the 10 provinces, who worked throughout the year before their interview.

National Population Health Survey

The National Population Health Survey (NPHS), which began in 1994/95, collects information about the health of Canadians every two years. 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 longitudinal and cross-sectional components.

Cross-sectional sample: The 1994/95 and 1996/97 (cycles 1 and 2) cross-sectional samples are made up of longitudinal respondents and other members of their households, as well as individuals selected as part of supplemental samples, or buy-ins, in some provinces. In 1994/95, the majority of interviews were conducted in person. Most of the 1996/97 interviews were conducted by telephone, and additional respondents for the buy-ins were chosen using random digit dialing. The 1998/99 (cycle 3) cross-sectional sample is made up mostly of longitudinal respondents and their cohabitants. Again, most of the interviews were conducted by telephone. Although no buy-ins were added to the cycle 3 sample, infants born in 1995 or later and immigrants who entered Canada after 1994 were randomly selected and added to keep the sample representative. To replace sample lost to attrition, individuals in dwellings that were part of the original sampling frame but whose household members did not respond in 1994/95 were asked to participate.

NPHS data are stored in two files. The General file contains socio-demographic and some health information for each member of participating households. The Health file contains in-depth health information, which was collected for one randomly selected household member, as well as the information in the General file pertaining to that individual.

In 1994/95, in each selected household, 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 in 1996/97 and 1998/99, the person providing in-depth health information for the Health file was the randomly selected person for the household in cycle 1 (1994/95), and was usually the person who provided information on all household members for the General file in cycles 2 and 3, if judged to be knowledgeable to do so. In households added to the 1996/97 cross-sectional sample (buy-ins), one knowledgeable household member—not necessarily the randomly selected respondent for the Health file—provided information for all household members for the General file. For the 1998/99 cross-sectional sample (longitudinal respondents, immigrants, infants, and individuals in households that did not participate in cycle 1), the randomly selected respondent was usually the person who provided information for the General file, again, if judged knowledgeable.

The 1994/95 non-institutional sample for the 10 provinces consisted of 27,263 households, of which 88.7% agreed to participate. After application of a screening rule to maintain the representativeness of the sample, 20,725 households remained in scope. In 18,342 of these households, the selected person was aged 12 or older. Their response rate to the in-depth health questions was 96.1%, or 17,626 respondents.

Data sources – concluded

In 1996/97, the overall response rate at the household level was 82.6%. The response rate for the randomly selected individuals aged 2 or older in these households was 95.6%.

In 1998/99, the overall response rate was 88.2% at the household level. The response rate for the randomly selected respondents (aged 0 or older) in these households was 98.5%.

Longitudinal sample: Of the 17,626 randomly selected respondents in 1994/95, 14,786 were eligible members of the longitudinal panel, along with 468 persons for whom only general information was collected. An additional 2,022 of the 2,383 randomly selected respondents under age 12 were also eligible for the longitudinal panel. Thus, 17,276 respondents were eligible for re-interview in 1996/97, and 16,677 were still alive in 1998/99. A response rate of 93.6% was achieved for the longitudinal panel in 1996/97, and a response rate of 88.9%, based on the entire panel, was achieved in 1998/99. Of the 16,168 participants in 1996/97, full information (that is, general and in-depth health information for the first two survey cycles or an outcome of death or institutionalization) was available for 15,670. The corresponding number for 1998/99 was 14,619. More detailed descriptions of the NPHS design, sample, and interview procedures can be found in published reports.[32,33]

The 1994/95 cross-sectional sample analyzed for this article consists of 6,856 respondents (3,583 men and 3,273 women) aged 18 to 54 living in the 10 provinces who worked throughout the entire year before their 1994/95 interview. Because of small sample sizes, night shift workers were excluded from some analysis (70 men and 42 women).

The longitudinal sample consists of records for which full information was collected in all three cycles and is based on the same target group (full-year workers who were 18 to 54 years old in 1994/95). In total, 4,877 longitudinal respondents were analyzed (2,520 men and 2,357 women). Again, night shift workers were excluded (49 men and 29 women). Weighted estimates based on the longitudinal sample are lower than those based on the 1994/95 cross-sectional file because individuals who died or were institutionalized by 1998/99 were excluded (Appendix Tables A to D).

Survey of Work Arrangements

Results from the Survey of Work Arrangements, conducted in 1991 and 1995, were used to produce trends in working shift. Both surveys were supplements to the Labour Force Survey for the month of November. The response rates were 94% and 90%, respectively. Shift work prevalence rates among full-year workers aged 18 to 54 were estimated for 1991 from a sample of 27,377 workers, and for 1995, from a sample of 21,250 workers.

Under normal conditions, biological functions such as body temperature, cognitive performance and hormonal secretions follow a 24-hour cycle.[26,34] Shift workers, however, must prepare for sleep when their natural body rhythms are telling them to be active, and they must be alert and ready to work when their bodies are preparing them for sleep. Most shift workers return to normal hours on their days off,[20] so the circadian system never fully adapts. This disruption of circadian rhythms has been found to be related to a variety of physical and mental symptoms.[10,34,35]

The association between shift work and health may be mediated by unhealthy behaviour—most often smoking.[10-13,36] And although results are inconsistent, some studies have found shift workers to be more likely than regular daytime workers to drink heavily, eat poorly and have weight problems.[5,10,11,13,26]

Stress has repeatedly been shown to be linked with physical health. Recently, researchers have suggested that shift work is a stressor that should be included in models examining relationships between occupational and personal stress, personal factors and physical and mental health.[37,38] Although the exact mechanisms are not fully understood, it is believed that stress may increase susceptibility to disease and play a pivotal role in the onset and progression of autoimmune diseases such as rheumatoid arthritis.[39-41]

Using data from the 2000/01 Canadian Community Health Survey (CCHS), this article provides an up-to-date profile of shift workers (see *Data sources, Analytical techniques* and *Limitations*). Four

types of shift are considered: evening, night, rotating and irregular. The National Population Health Survey (NPHS) is used to study the physical and mental health of shift workers both cross-sectionally and over time. Because of small sample sizes, it was not possible to consider night shift workers using NPHS data, and therefore, that analysis is restricted to those working evening, rotating or irregular shifts. Relationships between shift work and work stress, psycho-social problems, health behaviours, chronic conditions and psychological distress are examined using the 1994/95 NPHS cross-sectional file. Four-year incidence rates of chronic conditions and changes in psychological distress levels in relation to working shift in 1994/95 are studied using the first three cycles (1994/95, 1996/97 and 1998/99) of the NPHS longitudinal file. In all cases, comparisons are made with workers who had a regular daytime schedule. The analysis is based on full-year workers—those employed throughout the year before the survey—and thus focusses on workers with more than a marginal attachment to the labour force. Because job profiles differ for men and women, analyses are conducted separately for each sex.

More than a quarter work shift

In 2000/01, 30% of men and 26% of women aged 18 to 54 who were employed throughout the year had non-standard schedules (Table 1). About a quarter of them worked evening or night shifts. Rotating and irregular shifts were reported more frequently, each accounting for around 4 in 10 of these workers.

Analytical techniques

To investigate 10-year trends in working shift, comparisons of prevalence rates were made between the 1991 Survey of Work Arrangements, the 1994/95 National Population Health Survey (NPHS), the 1995 Survey of Work Arrangements, the 1996/97 and 1998/99 NPHS and the 2000/01 Canadian Community Health Survey (CCHS). To ensure consistent comparisons across reference years, these trends were based on all current workers (as opposed to full-year workers).

Unless otherwise noted, variable definitions are based on the questions from the first cycle (1994/95) of the NPHS. Cases where the variable definitions for work and socio-economic factors differ for the CCHS are noted.

Descriptive statistics from the CCHS were used to profile the population who worked various types of non-standard work schedules in 2000/01.

Cross-tabulations based on the 1994/95 NPHS cross-sectional file were used to examine associations between various schedules and work stress, psycho-social factors and unhealthy behaviours. The 1994/95 file was used because the work stress and some of the psycho-social questions (for example, personal stress and mastery) were not asked in subsequent NPHS cycles or for all provinces in the CCHS.

The NPHS 1994/95 cross-sectional file was also used to examine the relationship between shift work and the prevalence of chronic conditions and psychological distress levels.

The NPHS longitudinal file was used to examine four-year incidence of chronic conditions and changes in psychological distress levels (between 1994/95 and 1998/99) in relation to working shift in 1994/95. Based on a review of the literature and availability in the NPHS, several factors believed to mediate the relationship between shift work and health were accounted for in the multiple logistic regression models, including psycho-social factors, work stress, and health behaviours, as well as personal and employment characteristics.[8,10,13,15]

NPHS data (both cross-sectional and longitudinal) were weighted to represent the population in the 10 provinces in 1994/95. Sample sizes and weighted distributions for all factors included in the regression models can be found in the Appendix (Tables A through D). CCHS cross-sectional data were weighted to represent the population in the 10 provinces in 2000/01. Separate analyses were conducted for men and women, based on the weighted data.

To account for survey design effects, standard errors and coefficients of variation for all data from the NPHS and CCHS were estimated with the bootstrap technique.[42-44] Standard errors for rates derived from the Survey of Work Arrangements (1991 and 1995) were estimated based on the formulas for simple random sampling with the incorporation of a conservative estimate of a design effect to account for the complex sampling design of these surveys.

Table 1
Percentage of workers aged 18 to 54 employed throughout 2000/01 who worked shift, by sex and selected characteristics, Canada excluding territories

	Men						Women					
		Shift workers						Shift workers				
	Total workers	Total	Evening	Night	Rotating	Irregular	Total workers	Total	Evening	Night	Rotating	Irregular
	'000	%					'000	%				
Total	5,745	30	4	3	11	11	4,732	26	5	2	10	10
Occupation												
While-collar/Clerical†	2,697	21	2	1	8	10	2,915	18	3	1	8	7
Sales/Service	911	40*	9*	4*	12*	15*	1,172	41*	10*	2*	14*	15*
Blue-collar	1,866	36*	5*	4*	16*	12*	376	33*	7*E1	5*E1	12*	11*
Weekly work hours												
1-29	264	59*	20*	4E1	11	24*	804	44*	13*	2	10	19*
30-40†	2,449	27	6	3	12	6	2,646	22	4	2	10	6
More than 40	3,011	29*	2*	2*	11	14*	1,273	23	2*	2	9*	11*
Weekend worker												
Yes†	2,442	48	5	3‡	19	21	1,826	52	9	3	21	19
No	3,301	16*	4*	3*	6*	4*	2,906	10*	2*	1*	3*	4*
Self-employed												
Yes†	1,018	32	1E1	1E1	4	26	519	34	3	1E2	4	26
No	4,727	30*	5*	3*	13*	8*	4,212	25*	5*	2*	11*	8*
Age group												
18-24	669	46*	13*	6*	14	14*	621	46*	14*	2	14*	15*
25-34†	1,493	30	4	4	12	11	1,147	26	5	2	11	8
35-44	1,995	28*	3	3*	11	11	1,611	23*	4	2	9*	9
45-54	1,588	25*	3	2*	10*	11	1,354	21*	3*	2E1	8*	9
Marital status												
Married†	3,911	26	3	2	11	10	3,128	23	4	1	9	9
Never or previously married	1,831	37*	8*	5*	12*	13*	1,600	32*	7*	3*	12*	11*
Child(ren) under age 12 in household												
Yes†	2,108	28	4	2	11	11	1,533	26	5	2	10	9
No	3,637	31*	5*	3*	11	12	3,200	26	5	2	10	10
Postsecondary graduation												
Yes†	3,255	25	3	2	10	10	2,788	24	4	2	10	9
No	2,445	37*	6*	4*	13*	13*	1,913	30*	7*	2§	10	11*
Household income												
Lower†	991	35	7	5	9	14	943	35	8	3	11	13
Higher	4,347	28*	4*	2*	12*	11*	3,430	24*	4*	2*	10	8*

***Data source**: 2000/01 Canadian Community Health Survey, Cycle 1.1*
***Notes:** Based on 24,364 male and 22,398 female respondents. Of the men, 875 worked evening shift, 606 night shift, 3,166 rotating shift, and 3,080 irregular shift. Sample sizes for women were 1,007 for evening shift, 397 for night shift, 2,501 for rotating shift, and 2,325 for irregular shift. Because of rounding, detail by type of shift may not add to total shift workers. Rates are not presented for cases where the value for a variable is missing.*
† Reference category
‡ The percentage of men working weekends who were night shift workers (3.32%) was significantly higher than the rate for men who did not work weekends (2.54%).
§ The percentage of women with postsecondary graduation working the night shift (1.52%) was significantly lower than the rate for women without postsecondary graduation (2.31%).
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%
** Significantly different from reference category ($p < 0.05$)*

Not all workers were equally likely to work shift (see *Work factors*). Shift work was more common for individuals in blue-collar or sales and service occupations than for those in white-collar or clerical jobs. Men and women working less than 30 hours a week and men working more than 40 hours a week were more likely than those averaging 30 to 40 hours to have non-standard schedules. As well, people who worked on weekends were more likely than those who did not to be shift workers. Relatively few self-employed individuals had an evening, night or rotating schedule, but a considerable number worked irregular hours.

Work factors

The data in this article dealing with work schedule, occupation, weekend work and self-employment are based on the respondent's main job; that is, the current or most recent job in the past year. If the respondent had more than one current or most recent job, the main job was defined as the one with the highest number of weekly work hours.

In the first National Population Health Survey (NPHS) cycle in 1994/95, "main job" was based on the respondent's perception of "main." In subsequent cycles and in the Canadian Community Health Survey (CCHS), the definition based on current or most recent job was implemented. Therefore, to establish a consistent definition across all cycles on the NPHS longitudinal file, the 1994/95 main job was re-derived based on the new definition. Because occupation and self-employment status were asked only for the main job in 1994/95, these variables were set to "non-stated" if the main job was different. All other employment variables were asked for all jobs held throughout the year before the interview, and could therefore be re-derived based on the new definition of main job.

Work schedule was derived based on the question, "Which of the following best describes the hours you usually work at this job?" There were eight possible responses: regular daytime schedule or shift; regular evening shift; regular night shift; rotating shift; split shift; on call; irregular schedule; or other. *Shift work* was defined as anything but a regular daytime schedule. Four categories of shift workers were used in this analysis: *evening shift, night shift*, *rotating shift*, and *irregular shift*. An irregular shift was defined to include split shift, on call, irregular schedule and other. For the analyses based on NPHS data, night shift workers were excluded because of small sample sizes. If respondents asked for clarification of the various shifts, the following definitions were given:

A *regular daytime schedule* or shift refers to work beginning after 6:00 a.m. and ending before 7:00 p.m.

A *regular evening shift* refers to work beginning after 3:00 p.m. and ending before midnight.

A *regular night shift* refers to work beginning after 11:00 p.m. and ending before 11:00 a.m.

A *rotating shift* changes periodically from days to evenings or to nights.

A *split shift* has two or more distinct periods each day; for example, a bus driver working from 6:30 a.m. to 10:30 a.m. and from 2:00 p.m. to 6:00 p.m.

For the NPHS, *occupation* was categorized as *white-collar* (administrative and professional); *clerical*; *sales or service*; and *blue-collar*, based on the 1980 Standard Occupational Classification (SOC). For the CCHS, *occupation* was derived based on the question, "Which of the following best describes your occupation?" The response categories were classified into the following three groups: *white-collar and clerical* (management; professional; technologist, technician, or technical occupation; administrative, financial or clerical), *sales or service*, and *blue-collar* (trades, transport or equipment operator; occupation in farming, forestry, fishing or mining; occupation in processing, manufacturing or utilities).

For the NPHS, respondents were asked how many hours per week they usually worked at each job they held in the year before their 1994/95 interview. In addition, dates were collected for each job so that it was possible to calculate the number of weeks the respondent worked at each job during the year. With this information, the average number of hours worked per week during the reference year was calculated across all jobs. Individuals' *weekly work hours* were classified into three categories based on the average number of hours worked: 1 to 29, 30 to 40, or more than 40. For the CCHS, hours of work was only asked for the current job(s) or the job(s) last held in the reference year. The derivation of hours was based on this job (or jobs, if more than one was held at the same time).

Respondents were classified as *weekend workers* if they indicated that they usually worked weekends at their main job.

Respondents who indicated that they "worked mainly in their own business, farm or professional practice" were classified as *self-employed*.

The likelihood of working shift decreased with advancing age (see *Socio-economic factors*). Older workers with seniority may have more choice in their hours than do younger, less experienced workers. As well, it is more difficult for older people to deal with shift work,[5,20,45] and consequently, many switch to jobs with regular daytime schedules. The progressive intolerance to shift work associated with aging may be due to the flattening of circadian rhythms that occurs as individuals reach their forties and fifties, or to a decline in the ability to cope with stress.[20,46,47]

Single or previously married workers were more likely than those who were married to have non-standard work schedules. This is not surprising, given that shift work is associated with problems in family life, lower marital satisfaction and higher domestic friction.[1,48]

Male workers living in households with children were less likely than those in childless households to work shift. There was no difference for female workers, which may be because women were more likely than men to cite caring for family as their main reason for shift work (see *Reasons for working shift*).

Socio-economic factors

Four *age groups* were established for this analysis: 18 to 24, 25 to 34, 35 to 44, and 45 to 54.

Respondents were grouped into two *education* categories based on the highest level attained: postsecondary graduation and less than postsecondary graduation. Postsecondary graduation includes diplomas and certificates from trade, technical or vocational schools or business colleges; diplomas and certificates from community colleges, CEGEPs or nursing schools, and university degrees. Although the categories of this variable are common to both the National Population Health Survey and the Canadian Community Health Survey, the questions used to derive these groupings vary between the two surveys.

Respondents were asked their current *marital status*. Those who indicated "now married," "common-law" or "living with partner" were grouped as "married."

Household income was categorized into two groups based on the number of people in the household and total household income from all sources in the 12 months before the interview:

Household income group	People in household	Total household income
Lower	1 to 2	Less than $30,000
	3 or 4	Less than $40,000
	5 or more	Less than $60,000
Upper	1 or 2	$30,000 or more
	3 or 4	$40,000 or more
	5 or more	$60,000 or more

Reasons for working shift

According to the 2000/01 Canadian Community Health Survey, both male and female workers' main reason for non-standard hours was that it was a requirement of the job—they had no choice. Of the three types of non-standard work schedules considered—evening, rotating and irregular— men were more likely than women to cite "job requirement," and women were more likely than men to cite "caring for family." The percentage of workers reporting "no choice" were highest for the rotating shift (94% of men and 91% of women), and lowest for the evening shift.

Reason for non-standard hours, by type of shift and sex, workers aged 18 to 54 employed throughout 2000/01, Canada excluding teritories

	Evening†		Rotating		Irregular	
	Men	Women	Men	Women	Men	Women
	%		%		%	
No choice	65‡§	53‡§*	94§	91§*	84	73*
School	16‡§	20‡§	2§E1	3§E1	4E1	6*
Likes it	13‡§	13‡	3§	3§	7	10*
Caring for family	3‡§E1*	11‡§*	F	2§E1*	F	6*

Data source: *2000/01 Canadian Community Health Survey, Cycle 1.1*
Note: *Rates not presented for cases where reason for non-standard hours was "other" or missing*
† Excludes night shift
‡ Significantly different from rotating shift ($p < 0.05$, adjusted for multiple comparisons)
§ Significantly different from irregular shift ($p < 0.05$, adjusted for multiple comparisons)
E1 Coefficient of variation between 16.6% and 25.0%
F Coefficient of variation greater than 33.3%
** Significantly different from men ($p < 0.05$)*

Workers who were postsecondary graduates were not as likely as those with less education to report non-standard schedules. Comparatively high percentages of workers in lower-income households reported an evening, night or irregular shift. However, rotating shifts were relatively common among men from more affluent households. This may partly be attributable to the tendency for men in health professions and protection services, whose incomes were quite high (data not shown), to work rotating shifts.

Work stress

If people working shift are more likely than those with regular schedules to experience work stress, this may confound relationships between shift work and various health outcomes (see *Work stress*). Work stress has been linked to a variety of health problems such as depression, anxiety, migraine, high blood pressure and coronary heart disease.[49-56] In fact, failure to control for work stress is a limitation often cited in studies examining the relationship between shift work and health.[8,10,13,15]

And indeed, shift workers have relatively high levels of work stress (Table 2). In 1994/95, men and women working evening or rotating shifts were more likely than their counterparts with regular daytime schedules to report job strain (high psychological demands coupled with low decision-making latitude). Job insecurity was common among both men and women with a rotating or irregular schedule. Female workers on a rotating shift were more likely than those with a daytime schedule to perceive low support from their co-workers. High physical demands were reported by women on an evening, rotating or irregular shift, and by men on a rotating shift.

Psycho-social problems

Non-standard hours can limit a worker's participation in leisure-time and family activities (see *Psycho-social factors*). The strain of shift work on family life can lead to social support problems and stress.[1,26] While data from the 1994/95 NPHS support a link between shift work and psycho-social problems, this varied with the type of shift and sex of the workers.

Work stress

To measure *work stress*, respondents to the National Population Health Survey (NPHS) were asked to rank their responses to the following 12 statements on a five-point scale ranging from "strongly agree" (score 1) "to strongly disagree" (score 5).

a) Your job requires that you learn new things (reverse scored).
b) Your job requires a high level of skill (reverse scored).
c) Your job allows you freedom to decide how you do your job (reverse scored).
d) Your job requires that you do things over and over.
e) Your job is very hectic (reverse scored).
f) You are free from conflicting demands that others make.
g) Your job security is good.
h) Your job requires a lot of physical effort (reverse scored).
i) You have a lot to say about what happens in your job (reverse scored).
j) You are exposed to hostility or conflict from the people you work with (reverse scored).
k) Your supervisor is helpful in getting the job done.
l) The people you work with are helpful in getting the job done.

Five components of work stress were assessed:

1) *Job strain* was measured as a ratio of psychological demands (items e and f) to decision latitude. Items pertaining to decision latitude include skill discretion (a, b and d) and decision authority (c and i).[56] So that the potential contribution of each item to the scores for decision latitude and psychological demands would be equal, the summed scores of the responses to the items pertaining to each were divided by 5 and 2, respectively. The ratio for job strain was then calculated by dividing the new score for psychological demands by that for decision latitude. For values of the ratio that fell in the upper quartile of the distribution based on the 1994/95 NPHS cross-sectional file (scores equal to or greater than 1.18), the respondent was categorized as having high job strain. Cronbach's alpha was used to assess the internal consistency of the job strain scale: 0.61 for decision latitude and 0.34 for psychological demands of work.

2) *Physical demand* was measured by item h. Respondents who answered "strongly agree" or "agree" were categorized as experiencing high physical demands.

3) *Supervisor support* was measured by item k. Respondents who answered "strongly disagree" or "disagree" were categorized as receiving low support from their supervisor.

4) *Co-worker support* was measured by items j and l. Respondents who answered "strongly agree" or "agree" to item j or "strongly disagree" or "disagree" to item l were categorized as receiving low support from their co-workers.

5) *Job insecurity* was measured by item g. Respondents who answered "strongly disagree" or "disagree" were categorized as experiencing high job insecurity.

Table 2
Prevalence of work stress, psycho-social problems and health behaviours, by sex and work schedule, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

	Men				Women			
	Regular daytime	Evening shift†	Rotating shift	Irregular shift	Regular daytime	Evening shift†	Rotating shift	Irregular shift
	%				%			
Work stress								
High job strain	17	30*E1	29*	19	29	40*	45*	34
High physical demands	47	56	59*	50	34	54*	68*	52*
Low supervisor support	19	31E1	17	16	17	17E2	17E1	17
Low co-worker support	32	37	36	29	34	37	52*	34
High job insecurity	17	27E2	24*	23*	18	19E1	26*	31*
Psycho-social problems								
High personal stress	33	44	36	32	43	41	45	54*
Married - problems with partner	16	36*E2	22	19	21	29E1	24E1	25
Single - difficulty finding a partner	33	55*	35	35	34	30E1	39E1	19*E1
Low mastery	20	32*E1	23	15*	23	24E1	31*	24
Health behaviours								
Daily smoker	27	45*	33	28	23	28	30	26
Inactive	59	47	54	54	66	62	63	62
Heavy drinker	21	27E1	26	18	6	F	5E2	7E1
Obese	13	9E2	15	10	11	10E2	12E1	12E1

Data source: *1994/95 National Population Health Survey, cross-sectional sample, Health file*
Notes: *Based on 3,583 male and 3,273 female respondents. Of the men, 2,507 worked daytime schedule, 137 evening shift, 465 rotating shift, 471 irregular shift, and 3 not stated. Sample sizes for women were 2,431 for daytime schedule, 149 for evening shift, 335 for rotating shift, 356 for irregular shift, and 2 not stated.*
† Excludes night shift workers
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%
F Coefficient of variation greater than 33.3%
** Significantly different from regular daytime schedule ($p < 0.05$)*

Psycho-social factors

In the National Population Health Survey, five "true/false" statements were used to measure *personal stress*:

- You are trying to take on too many things at once.
- There is too much pressure on you to be like other people.
- Too much is expected of you by others.
- Your work around the home is not appreciated.
- People are too critical of you or what you do.

A score of 1 was assigned to each "true" response. High personal stress was defined as a score of 2 or more, and accounted for 33% of the weighted distribution of the 1994/95 cross-sectional file, based on individuals aged 18 or older.

Relationship problems were assessed with three "true/false" statements for people who were married (married, living with a partner or in a common-law union) and one for people who were single (single, widowed, divorced or separated). The items for married respondents were:

- Your partner doesn't understand you.
- Your partner doesn't show enough affection.
- Your partner is not committed enough to your relationship.

The item for single respondents was:

- You find it very difficult to find someone compatible with you.

Married people who answered "true" to at least one of their three items and single people who answered "true" to their one item were categorized as having a relationship problem.

To measure *mastery*, respondents were asked to react to seven items, which were ranked on a five-point scale ranging from "strongly agree" (score 0) to "strongly disagree" (score 4).

- You have little control over the things that happen to you.
- There is really no way you can solve the problems you have.
- There is little you can do to change many of the important things in your life.
- You often feel helpless in dealing with the problems of life.
- Sometimes you feel you are being pushed around in life.
- What happens in the future mostly depends on you (reverse scored).
- You can do just about anything if you set your mind to it (reverse scored).

The responses to all items were summed (ranging from 0 to 28), with a higher score indicating a higher sense of mastery (Cronbach's alpha = 0.76). Respondents scoring 17 or less, who represented the lower quartile of the weighted distribution of the 1994/95 cross-sectional file, were categorized as having low mastery.

For men, the evening shift, in particular, was associated with psycho-social difficulties. Married men working an evening shift were more likely than those with regular daytime hours to report relationship problems. And single men who worked an evening shift were more likely than those with a daytime schedule to report difficulty finding someone with whom they were compatible. As well, for men, the evening shift was associated with low levels of mastery, meaning that they were more likely than daytime workers to perceive a lack of control in their lives. By contrast, men working irregular shifts had a relatively high sense of mastery, which may reflect irregular hours among the self-employed.

Health behaviours

The National Population Health Survey defined *daily smokers* as those who indicated that they smoked cigarettes every day.

Level of physical activity was based on total accumulated energy expenditure (EE) during leisure time. EE was calculated from the reported frequency and duration of all of a respondent's leisure-time physical activities in the three months before his or her NPHS interview and the metabolic energy demand (MET values) of each activity, which was independently established.[57,58]

$EE = 3 (N_i * D_i * METS_i/365 \text{ days})$, where

N_i = number of occasions of activity i in a year,

D_i = average duration in hours of activity i, and

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

For each respondent, daily EE was the sum of energy expenditures of all leisure-time activities, expressed as total kilocalories expended per kilogram of body weight per day (KKD). An EE of 3 or more KKD was defined as high; 1.5 to 2.9 KKD, moderate; and less than 1.5 KKD, low.[57] Respondents with high or moderate EE were considered physically active; those with low EE, *inactive*.

Heavy drinking was measured by asking respondents the number of times in the past year they had had five or more alcoholic drinks on one occasion. Those who answered 12 or more times were classified as *heavy drinkers*.

Weight was defined using body mass index (BMI), which was calculated by dividing weight in kilograms by the square of height in metres (pregnant women were excluded). BMI was grouped into two categories: *obese* (BMI 30 or more) and not obese (BMI less than 30; the reference group).

For women, the evening shift was not associated with psycho-social problems, possibly because such a schedule was often a choice. However, women who worked an irregular shift were more likely than those with a daytime schedule to report high personal stress (taking on too much, feeling pressured and unappreciated). And women working a rotating schedule were more likely than regular daytime workers to have low mastery.

Health behaviours

Individuals attempting to cope with sleep/wake disturbances, family upset, and the stress brought about by shift work may adopt unhealthy habits (see *Health behaviours*).[10,13] However, in 1994/95, the only significant difference in health behaviour between shift and daytime workers was among men working the evening shift, a high percentage of whom were daily smokers. Differences in the prevalence of inactivity during leisure time, heavy drinking, and obesity were not significant.

Physical and emotional health

Previous research indicates a relationship between non-standard work schedules and specific chronic conditions such as cardiovascular disease, hypertension and gastrointestinal disorders (see *Health outcomes*).[8,10,11,13-19] Yet when the generally lower socio-economic status, high work stress, psycho-social problems and smoking habits of shift workers were taken into account along with their demographic and employment characteristics, the prevalence of chronic conditions in 1994/95 among shift workers did not differ significantly from that of daytime workers (Table 3).

The disruption in circadian rhythms and the social isolation brought about by shift work are believed to contribute to mental health problems.[26,35] The fact that shift workers get less sleep than regular daytime workers could exacerbate the situation (see *Shift work and sleep*).[28,29] Even so, once their demographic, socio-economic and other employment characteristics were taken into account, in 1994/95, distress levels among men and women with non-standard schedules were similar to those of workers with regular daytime schedules (Table 4).

Table 3
Adjusted odds ratios relating selected characteristics to chronic conditions, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

	Men		Women	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Work schedule†				
Regular daytime‡	1.0	…	1.0	…
Evening shift	0.6	0.3, 1.1	1.0	0.6, 1.6
Rotating shift	0.7	0.5, 1.0	0.8	0.6, 1.2
Irregular shift	1.2	0.9, 1.6	1.2	0.9, 1.6
Occupation				
White-collar‡	1.0	…	1.0	…
Clerical	1.9*	1.2, 3.2	1.1	0.8, 1.5
Sales/Service	0.9	0.6, 1.2	1.0	0.7, 1.3
Blue-collar	1.1	0.8, 1.4	0.9	0.6, 1.3
Weekly work hours				
1-29	1.4	0.9, 2.2	0.9	0.7, 1.1
30-40‡	1.0	…	1.0	…
More than 40	0.9	0.7, 1.1	1.0	0.8, 1.4
Weekend worker	1.3*	1.0, 1.6	1.2	0.9, 1.6
Self-employed	0.9	0.7, 1.2	0.7	0.5, 1.1
Age group				
18-24	1.0	0.6, 1.6	0.8	0.5, 1.1
25-34‡	1.0	…	1.0	…
35-44	1.7*	1.3, 2.2	1.3*	1.0, 1.8
45-54	2.6*	1.9, 3.5	2.0*	1.4, 2.7
Married	1.5*	1.1, 2.0	0.9	0.8, 1.2
Child(ren) under age 12 in household	0.9	0.7, 1.2	1.1	0.9, 1.4
Postsecondary graduation	0.8*	0.6, 1.0	1.0	0.8, 1.2
Lower household income	0.9	0.7, 1.1	0.9	0.7, 1.1
Work stress				
High job strain	1.3	0.9, 1.8	1.0	0.8, 1.2
High physical demands	0.8	0.7, 1.1	1.4*	1.1, 1.7
Low supervisor support	0.7*	0.5, 1.0	1.1	0.8, 1.4
Low co-worker support	1.2	1.0, 1.6	1.3*	1.1, 1.7
High job insecurity	1.2	0.9, 1.7	1.5*	1.2, 2.0
Psycho-social factors				
High personal stress	1.6*	1.3, 2.0	1.4*	1.2, 1.8
Relationship problems	1.2	0.9, 1.6	0.9	0.7, 1.2
Low mastery	0.9	0.7, 1.2	1.1	0.9, 1.4
Health behaviours				
Daily smoker	1.3*	1.0, 1.6	1.4*	1.1, 1.7
Inactive	1.0	0.8, 1.2	1.0	0.8, 1.2
Heavy drinker	1.2	0.9, 1.5	0.7	0.5, 1.0
Obese	1.2	0.9, 1.6	1.1	0.8, 1.6

Data source: *1994/95 National Population Health Survey, cross-sectional sample, Health file*
Notes: *Analysis based on 3,246 men and 3,147 women; 1,008 men and 1,161 women were categorized as having one or more chronic conditions in 1994/95; 337 male respondents and 126 female respondents were dropped from models because of missing values. "Missing" categories for occupation, self-employed, household income, work stress, and obese variables were included in models to maximize sample size, but their odds ratios are not shown. When not noted, reference category is absence of characteristic; for example, reference category for "weekend worker" is "not weekend worker." Because of rounding, some confidence intervals with 1.0 as lower/upper limit are significant.*
† Excludes night shift workers
‡ Reference category
** $p < 0.05$*
… Not applicable

Table 4
Regression coefficients relating selected characteristics to psychological distress levels, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

	Men			Women		
	B	95% confidence interval	beta	B	95% confidence interval	beta
Work schedule†						
Regular daytime‡	…	…	…	…	…	…
Evening shift	0.31	-0.46, 1.08	0.02	-0.22	-0.71, 0.27	-0.02
Rotating shift	0.00	-0.34, 0.35	0.00	-0.02	-0.48, 0.44	0.00
Irregular shift	0.01	-0.31, 0.33	0.00	0.20	-0.19, 0.60	0.02
Occupation						
White-collart‡	…	…	…	…	…	…
Clerical	0.18	-0.41, 0.77	0.02	-0.16	-0.46, 0.15	-0.02
Sales/Service	-0.08	-0.44, 0.28	-0.01	-0.10	-0.45, 0.24	-0.02
Blue-collar	-0.38*	-0.65, -0.12	-0.07*	0.24	-0.26, 0.74	0.02
Weekly work hours						
1-29	0.46	-0.05, 0.97	0.05	0.06	-0.25, 0.36	0.01
30-40‡	…	…	…	…	…	…
More than 40	-0.21	-0.43, 0.02	-0.04	-0.13	-0.41, 0.15	-0.02
Weekend worker	0.11	-0.11, 0.32	0.02	-0.18	-0.47, 0.11	-0.03
Self-employed	0.18	-0.10, 0.46	0.03	0.02	-0.40, 0.43	0.00
Age	-0.04*	-0.05, -0.02	-0.13*	-0.03*	-0.05, -0.02	-0.10*
Married	-0.15	-0.44, 0.15	-0.03	-0.27	-0.54, 0.01	-0.04
Child(ren) under age 12 in household	-0.12	-0.37, 0.13	-0.02	-0.29*	-0.54, -0.04	-0.05*
Postsecondary graduation	0.12	-0.11, 0.35	0.02	0.08	-0.17, 0.33	0.01
Lower household income	-0.11	-0.35, 0.13	-0.02	0.18	-0.10, 0.46	0.03
Work stress						
Job strain§	0.71*	0.30, 1.12	0.09*	0.27	-0.11, 0.65	0.04
Physical demands§	0.01	-0.08, 0.11	0.01	0.00	-0.11, 0.11	0.00
Supervisor support††	-0.06	-0.17, 0.04	-0.03	-0.08	-0.19, 0.03	-0.03
Co-worker support††	0.06	-0.02, 0.14	0.03	0.12*	0.04, 0.20	0.07*
Job insecurity§	0.05	-0.06, 0.15	0.02	0.04	-0.07, 0.14	0.02
Psycho-social factors						
Personal stress§	0.55*	0.44, 0.65	0.25*	0.50*	0.40, 0.61	0.23*
Relationship problems§	0.22	-0.07, 0.51	0.04	0.39*	0.09, 0.69	0.06*
Mastery§	-0.17*	-0.20, -0.14	-0.26*	-0.19*	-0.22, -0.16	-0.28*
Health behaviours						
Daily smoker	0.16	-0.09, 0.42	0.03	0.42*	0.14, 0.69	0.06*
Inactive	0.09	-0.12, 0.29	0.02	0.02	-0.22, 0.26	0.00
Heavy drinker	0.33*	0.11, 0.56	0.05*	0.55*	0.08, 1.02	0.05*
Obese	-0.18	-0.47, 0.11	-0.02	-0.16	-0.48, 0.16	-0.02
Intercept	6.12	4.93, 7.31		6.85	5.77, 7.93	

Data source: *1994/95 National Population Health Survey, cross-sectional sample, Health file*
Notes: *Based on 3,111 men and 3,006 women; 472 male respondents and 267 female respondents were dropped from models because of missing values. "Missing" categories for occupation, self-employment, household income, and obese variables were included in models to maximize sample size, but their respective B and beta coefficients are not shown. When not noted, reference category is absence of characteristic; for example, reference category for "weekend worker" is "not weekend worker."*
† Excludes night shift workers
‡ Reference category
§ Coded from low to high
†† Coded from high to low
** $p < 0.05$*
R^2=.26; Adj. R^2=.25; df=31 3,079 for men
R^2=.26; Adj. R^2=.25; df=31 2,974 for women
… Not applicable

Health outcomes

Two health outcomes were considered for the analysis in this article: chronic conditions and psychological distress.

To determine the presence of *chronic conditions*, respondents to the National Population Health Survey were asked if they had "any long-term health conditions that have lasted or are expected to last six months or more that have been diagnosed by a health professional." A checklist of conditions was read to them. Conditions considered in this analysis were: asthma, arthritis or rheumatism, back problems (excluding arthritis), high blood pressure, migraine, chronic bronchitis or emphysema, diabetes, epilepsy, heart disease, cancer, and stomach or intestinal ulcers. Respondents were classified as having "none" or "one or more" of these conditions in 1994/95. For analyses based on the longitudinal file, respondents were classified as having a new chronic condition if they reported at least one condition from the checklist in 1998/99 that they had not reported in 1994/95.

Distress in 1994/95 was based on responses to the following questions:

- During the past month, about how often did you feel so sad that nothing could cheer you up?
- During the past month, how often did you feel
  - ... nervous?
  - ... restless or fidgety?
  - ... hopeless?
  - ... worthless?
- During the past month, how often did you feel that everything was an effort?

Each question was answered on a five-point scale: "all of the time" (score 4), "most of the time" (3), "some of the time" (2), "a little of the time" (1) or "none of the time" (0). Responses to all items were scored and summed; the possible range of scores was 0 to 24, with a higher score indicating more distress. The average score was 3.5, with a standard deviation of 3.4. To deal with outlying values that resulted in skewness in the distribution, scores more than two standard deviations over the mean were capped (that is, scores greater than 10 were capped at 10). Values were capped for less than 5% of records. For analyses based on the longitudinal file, changes in distress scores were examined. For each record on the longitudinal file, the difference in distress scores between 1996/97 and 1994/95 was calculated as the score in 1996/97 minus the score in 1994/95. Likewise the difference between 1998/99 and 1994/95 was set to the 1998/99 value minus the 1994/95 value. Again, changes greater than two standard deviations above or below the mean change were capped (around 6% of records).

That is, shift workers were no more or less likely to report feeling sad, nervous, restless, hopeless, worthless, or that everything was an effort.

The lack of a cross-sectional relationship between shift work and chronic conditions or distress may be because many workers have trouble adjusting to shift work right from the start and transfer to a regular daytime schedule after a short period.[47] For these workers, symptoms of illness such as sleep disturbance, gastrointestinal complaints and mood disturbance are apparent from the outset.[34] The terms "shift work intolerance" or "shift maladaptation syndrome" have been used to describe this phenomenon.[34,59] Because such people

Shift work and sleep

Although the night shift is believed to be the most disruptive to sleep,[1] data from the 2000/01 Canadian Community Health Survey reveal that other types of shift work are associated with sleep problems. Compared with regular daytime workers, men and women who worked an evening, rotating or irregular shift tended to have problems such as trouble falling or staying asleep, getting less than six hours of sleep in a 24-hour period, and not finding sleep refreshing. While several studies have attributed shift workers' sleep problems to noise, disturbances in circadian rhythms may exert a stronger influence.[4,20]

Prevalence of sleep problems, by work schedule† and sex, workers aged 18 to 54 employed throughout 2000/01, Canada excluding territories

	Regular daytime	Evening shift	Rotating shift	Irregular shift
			%	
Men				
Trouble falling/staying asleep most of time/sometimes	38	45*	44*	41*
Less than 6 hours sleep	10	13	15*	16*
Sleep not always refreshing	30	40*	36*	33
Women				
Trouble falling/staying asleep most of time/sometimes	48	49	51*	54*
Less than 6 hours sleep	9	13*	13*	11*
Sleep not always refreshing	36	45*	43*	41*

Data source: *2000/01 Canadian Community Health Survey, Cycle 1.1*
† Excludes night shift workers
** Significantly different from regular daytime ($p < 0.05$)*

tend to stop working shift in a relatively short time, their physical and psychological problems may not be apparent in a cross-sectional analysis.

In the long run

While there was no cross-sectional relationship between shift work and chronic conditions or psychological distress, analysis of NPHS longitudinal data indicates that those who worked shift in 1994/95 were at some increased risk over the long run.

For men, a non-standard schedule in 1994/95 was predictive of developing chronic conditions in the next four years (Table 5). Compared with men who had a regular daytime schedule, those working an evening, rotating or irregular shift in 1994/95 all had increased odds of having been diagnosed with at least one new chronic condition by 1998/99.

For women, a non-standard schedule in 1994/95 was not associated with a new diagnosis of chronic conditions. This may be because, more than men, women worked shift to accommodate other needs such as caring for family or going to school. It has been suggested that commitment to shift work may be the most important individual factor related to the ability to tolerate it.[47] Another possibility is that certain chronic conditions among women were associated with working shift, but limited sample sizes meant that the analysis could not be carried out at a level of detail that would reveal these relationships.

For both sexes, working the evening shift in 1994/95 was associated with an increase in psychological distress between 1994/95 and 1996/97 (Table 6). By 1998/99, however, the average predicted distress level of people who had worked the evening shift in 1994/95 did not differ from that of regular daytime workers (Table 7).

The lack of a cross-sectional relationship between shift work and distress and the reduction of distress over four years among people who worked the evening shift in 1994/95 suggest that they either ceased working shift or learned to cope with a non-standard schedule.

Limitations

In this analysis, it was not possible to control for the length of time that people had been working shift, and therefore, associations between shift work and health outcomes may be obscured.

The variable for shift work was derived based on information about the respondent's main job (see *Work factors*). Some respondents had more than one job, and schedules may have differed from the main one.

Small sample sizes prevented a full analysis of some issues. For example, it was not possible to carry out a detailed analysis of transitions into and out of shift work over time (between National Population Health Survey cycles). Also, night shift workers had to be excluded from most analyses based on NPHS data. In the NPHS longitudinal file, 29 men and 49 women worked the night shift in 1994/95. Some consideration was given to grouping them with evening or rotating shift workers. However, this might distort the analyses and make it difficult to interpret the results.

Sample sizes were also relatively small for the evening shift (98 men and 103 women), which, in some cases, may have resulted in findings that are not statistically significant.

It was necessary to group chronic conditions. Possibly, some individual conditions were significantly associated with working shift, while others were not. Furthermore, the four-year follow-up, 1994/95 to 1998/99, may be too brief for the full effect of associations between shift work and chronic conditions to emerge. For the NPHS, a chronic condition is defined as one that has lasted or is expected to last six months or longer, and that has been diagnosed by a health professional. It is not possible to know if the conditions reported satisfied all the criteria. As well, proxy reporting was permitted for questions about chronic conditions, which may affect the reported prevalence and incidence.[60] Diagnoses were not verified by an independent source, so inaccuracies may exist for both proxy and self-reported data.

Most interviews in the first NPHS cycle (1994/95) were conducted in person; in subsequent cycles (1996/97 and 1998/99), most were conducted by telephone. To some extent, changes in psychological distress levels between cycles may reflect this change in collection methodology. Some studies suggest that collecting information about psychiatric symptoms by telephone results in fewer problems being reported, compared with face-to-face interviews;[61] other studies have found no significant differences.[62,63]

Table 5
Adjusted odds ratios relating selected characteristics in 1994/95 to incidence of one or more chronic conditions between 1994/95 and 1998/99, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

	Men		Women	
	Adjusted odds ratio	95% confidence interval	Adjusted odds ratio	95% confidence interval
Work schedule†				
Regular daytime‡	1.0	…	1.0	…
Evening shift	2.0*	1.0, 4.1	1.0	0.5, 2.0
Rotating shift	1.7*	1.1, 2.5	1.2	0.7, 1.9
Irregular shift	1.7*	1.1, 2.7	1.0	0.7, 1.5
Occupation				
White-collar‡	1.0	…	1.0	…
Clerical	1.5	0.7, 2.9	1.0	0.7, 1.3
Sales/Service	1.1	0.7, 1.8	1.2	0.8, 1.7
Blue-collar	1.1	0.8, 1.6	1.2	0.7, 2.1
Weekly work hours				
1-29	0.9	0.5, 1.8	0.8	0.6, 1.1
30-40‡	1.0	…	1.0	…
More than 40	0.9	0.6, 1.1	0.8	0.6, 1.1
Weekend worker	0.7*	0.5, 1.0	1.0	0.8, 1.4
Self-employed	1.2	0.8, 1.7	0.9	0.6, 1.4
Age group				
18-24	0.9	0.4, 1.8	0.9	0.5, 1.6
25-34‡	1.0	…	1.0	…
35-44	1.5*	1.1, 2.1	1.4*	1.0, 1.9
45-54	1.7*	1.2, 2.5	1.9*	1.3, 2.7
Married	1.4	1.0, 2.1	0.9	0.7, 1.2
Child(ren) under age 12 in household	0.6*	0.4, 0.9	1.0	0.8, 1.4
Postsecondary graduation	1.0	0.8, 1.4	0.9	0.7, 1.2
Lower household income	1.1	0.8, 1.5	1.1	0.8, 1.5
Work stress				
High job strain	1.0	0.7, 1.5	1.3	1.0, 1.7
High physical demands	1.2	0.8, 1.6	0.9	0.7, 1.2
Low supervisor support	1.1	0.7, 1.5	1.2	0.8, 1.6
Low co-worker support	1.0	0.7, 1.3	1.1	0.8, 1.4
High job insecurity	1.1	0.7, 1.5	0.9	0.6, 1.2
Psycho-social factors				
High personal stress	1.2	0.9, 1.6	1.0	0.8, 1.3
Relationship problems	1.0	0.7, 1.4	1.2	0.9, 1.7
Low mastery	1.0	0.7, 1.5	1.3	1.0, 1.7
Health behaviours				
Daily smoker	1.4*	1.1, 1.9	1.1	0.8, 1.5
Inactive	1.0	0.7, 1.2	0.9	0.7, 1.1
Heavy drinker	0.8	0.6, 1.1	1.3	0.8, 2.1
Obese	2.0*	1.4, 2.8	1.7*	1.2, 2.4
One or more chronic conditions in 1994/95	1.0	0.7, 1.3	1.2	0.9, 1.6

Data source: *1994/95, 1996/97, 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on 2,284 men and 2,273 women; 497 men and 594 women were categorized as being diagnosed with a new chronic condition between 1994/95 and 1998/99; 236 male respondents and 84 female respondents were dropped from models because of missing values. "Missing" categories for occupation, self-employed, household income, work stress, and obese variables were included in models to maximize sample size, but their odds ratios are not shown. When not noted, reference category is absence of characteristic; for example, reference category for "weekend worker" is "not weekend worker." Because of rounding, some confidence intervals with 1.0 as lower/upper limit are significant.*
† Excludes night shift workers
‡ Reference category
** $p < 0.05$*
··· Not applicable

Table 6
Regression coefficients relating selected characteristics in 1994/95 to changes in psychological distress levels between 1994/95 and 1996/97, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

	Men			Women		
	B	95% confidence interval	beta	B	95% confidence interval	beta
Work schedule†						
Regular daytime‡	…	…	…	…	…	…
Evening shift	0.86*	0.14, 1.57	0.07*	0.62*	0.01, 1.22	0.04*
Rotating shift	0.06	-0.34, 0.45	0.01	0.20	-0.37, 0.76	0.02
Irregular shift	0.23	-0.10, 0.57	0.03	0.32	-0.25, 0.88	0.03
Occupation						
White-collar‡	…	…	…	…	…	…
Clerical	0.31	-0.33, 0.95	0.03	0.03	-0.29, 0.36	0.01
Sales/Service	-0.03	-0.40, 0.35	0.00	0.03	-0.37, 0.42	0.00
Blue-collar	0.09	-0.24, 0.42	0.02	-0.23	-0.86, 0.41	-0.02
Weekly work hours						
1-29	-0.17	-0.66, 0.32	-0.02	-0.08	-0.41, 0.25	-0.01
30-40‡	…	…	…	…	…	…
More than 40	-0.13	-0.39, 0.13	-0.02	0.01	-0.33, 0.34	0.00
Weekend worker	-0.09	-0.32, 0.15	-0.02	0.05	-0.26, 0.35	0.01
Self-employed	-0.10	-0.41, 0.21	-0.01	-0.22	-0.67, 0.24	-0.02
Age	-0.01	-0.02, 0.01	-0.02	0.01	-0.01, 0.02	0.02
Married	0.03	-0.33, 0.39	0.00	0.03	-0.26, 0.33	0.01
Child(en) under age 12 in household	-0.01	-0.30, 0.27	0.00	-0.16	-0.45, 0.14	-0.03
Postsecondary graduation	0.10	-0.16, 0.36	0.02	0.18	-0.11, 0.48	0.03
Lower household income	-0.29*	-0.57, -0.02	-0.05*	0.30	-0.03, 0.62	0.05
Work stress						
Job strain§	-0.03	-0.47, 0.41	0.00	0.15	-0.28, 0.58	0.02
Physical demands§	0.05	-0.05, 0.15	0.03	0.06	-0.05, 0.17	0.03
Supervisor support††	0.01	-0.11, 0.12	0.00	0.05	-0.07, 0.17	0.02
Co-worker support††	0.13*	0.04, 0.21	0.07*	0.01	-0.08, 0.09	0.00
Job insecurity§	0.06	-0.07, 0.18	0.02	0.01	-0.10, 0.13	0.01
Psycho-social factors						
Personal stress§	0.15*	0.02, 0.28	0.07	0.14*	0.02, 0.26	0.06*
Relationship problems§	-0.16	-0.45, 0.12	-0.03	0.16	-0.14, 0.45	0.02
Mastery§	0.01	-0.03, 0.04	0.01	-0.05*	-0.09, -0.02	-0.08*
Health behaviours						
Daily smoker	0.25*	0.01, 0.50	0.04*	0.19	-0.15, 0.52	0.03
Inactive	0.18	-0.04, 0.41	0.03	0.02	-0.24, 0.28	0.00
Heavy drinker	-0.15	-0.42, 0.12	-0.02	0.18	-0.41, 0.78	0.01
Obese	-0.10	-0.42, 0.22	-0.01	-0.19	-0.56, 0.18	-0.02
Distress level in 1994/95	-0.60*	-0.66, -0.54	-0.63*	-0.60*	-0.65, -0.55	-0.66*
Intercept	-0.03	-1.37, 1.31		1.18	-0.20, 2.56	

Data source: *1994/95, 1996/97, 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on 2,151 men and 2,150 women; 369 male respondents and 207 female respondents were dropped from models because of missing values. "Missing" categories for occupation, self-employed, household income, and obese variables were included in models to maximize sample size, but their B and beta coefficients are not shown. When not noted, reference category is absence of characteristic; for example, reference category for "weekend worker" is "not weekend worker."*
† Excludes night shift workers
‡ Reference category
§ Coded from low to high
†† Coded from high to low
** $p < 0.05$*
R^2=.37; Adj. R^2=.36; df=32 2,118 for men
R^2=.37; Adj. R^2=.36; df=32 2,117 for women
… Not applicable

Table 7
Regression coefficients relating selected characteristics in 1994/95 to changes in psychological distress levels between 1994/95 and 1998/99, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

	Men			Women		
	B	95% confidence interval	beta	B	95% confidence interval	beta
Work schedule†						
Regular daytime‡	…	…	…	…	…	…
Evening shift	0.44	-0.34, 1.21	0.03	0.46	-0.27, 1.19	0.03
Rotating shift	-0.31	-0.67, 0.05	-0.04	0.40	-0.33, 1.13	0.04
Irregular shift	-0.04	-0.47, 0.39	0.00	-0.08	-0.65, 0.49	-0.01
Occupation						
White-collar‡	…	…	…	…	…	…
Clerical	0.17	-0.54, 0.88	0.01	-0.07	-0.43, 0.30	-0.01
Sales/Service	0.43*	-0.01, 0.88	0.06*	-0.17	-0.61, 0.27	-0.02
Blue-collar	0.06	-0.28, 0.39	0.01	-0.20	-0.70, 0.31	-0.02
Weekly work hours						
1-29	0.15	-0.45, 0.75	0.01	0.17	-0.18, 0.52	0.02
30-40‡	…	…	…	…	…	…
More than 40	-0.11	-0.41, 0.19	-0.02	-0.17	-0.54, 0.20	-0.02
Weekend worker	-0.15	-0.43, 0.13	-0.03	-0.28	-0.60, 0.04	-0.04
Self-employed	-0.11	-0.46, 0.25	-0.01	-0.13	-0.69, 0.43	-0.01
Age	0.01	-0.01, 0.03	0.03	-0.01	-0.02, 0.01	-0.02
Married	-0.22	-0.59, 0.14	-0.04	-0.02	-0.36, 0.32	0.00
Child(ren) under age 12 in household	0.29	-0.01, 0.58	0.05	-0.25	-0.59, 0.09	-0.04
Postsecondary graduation	-0.04	-0.33, 0.24	-0.01	0.13	-0.21, 0.46	0.02
Lower household income	-0.33*	-0.62, -0.04	-0.05*	0.26	-0.10, 0.61	0.04
Work stress						
Job strain§	-0.17	-0.59, 0.25	-0.02	0.12	-0.31, 0.55	0.01
Physical demands§	0.02	-0.09, 0.13	0.01	0.02	-0.12, 0.15	0.01
Supervisor support††	0.00	-0.13, 0.13	0.00	0.10	-0.03, 0.24	0.04
Co-worker support††	0.12*	0.04, 0.21	0.07*	-0.02	-0.11, 0.07	-0.01
Job insecurity§	0.20*	0.06, 0.33	0.08*	-0.17*	-0.32, -0.02	-0.07*
Psycho-social factors						
Personal stress§	0.09	-0.02, 0.20	0.04	0.04	-0.07, 0.15	0.02
Relationship problems§	-0.16	-0.49, 0.18	-0.02	0.29	-0.04, 0.62	0.04
Mastery§	0.00	-0.03, 0.04	0.00	-0.06*	-0.10, -0.02	-0.08*
Health behaviours						
Daily smoker	0.08	-0.19, 0.35	0.01	0.30	-0.06, 0.66	0.04
Physically inactive	0.15	-0.10, 0.39	0.03	-0.16	-0.44, 0.12	-0.03
Heavy drinker	0.09	-0.20, 0.38	0.01	-0.13	-0.77, 0.51	-0.01
Obese	-0.10	-0.43, 0.24	-0.01	0.04	-0.36, 0.44	0.00
Distress level in 1994/95	-0.63*	-0.69, -0.57	-0.62*	-0.59*	-0.65, -0.53	-0.62*
Intercept	-0.14	-1.56, 1.27		3.01*	1.38, 4.64	

Data source: *1994/95, 1996/97, 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on 2,150 men and 2,148 women; 370 male respondents and 209 female respondents were dropped from models because of missing values. "Missing" categories for occupation, self-employed, household income, and obese variables were included in models to maximize sample size, but, their B and beta coefficients are not shown. When not noted, reference category is absence of characteristic; for example, reference category for "weekend worker" is "not weekend worker."*
† Excludes night shift workers
‡ Reference category
§ Coded from low to high
†† Coded from high to low
** $p < 0.05$*
R^2=.38; Adj. R^2=.37; df=32 2,117 for men
R^2=.35; Adj. R^2=.34; df=32 2,115 for women
… Not applicable

A "shifting" workforce

Although the overall proportion of employed Canadians working shift has changed little over the past decade, transitions out of shift work are the rule, not the exception (see *Trends in working shift*). In the majority of cases, the transition is to a regular daytime schedule rather than to a different type of shift, or it involves leaving the labour force entirely (data not shown).

Of those who worked an evening, rotating or irregular shift in 1994/95, less than one in five maintained this schedule in both 1996/97 and 1998/99 (Table 8). In fact, the proportions who had an irregular shift in 1994/95 and continued with this schedule in 1996/97 and 1998/99 were just 12% for men and 11% for women. By contrast, about 75% of the men and women who worked regular daytime hours in 1994/95 did so as well in 1996/97 and 1998/99.

Table 8
Work schedule in 1994/95, 1996/97 and 1998/99, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

Work schedule† 1994/95	Full-year workers 1994/95	Same schedule 1996/97	Same schedule 1996/97 and 1998/99
	'000	%	%
Men			
Regular daytime	3,847	85	74
Evening shift	259	30*E1	F*
Rotating shift	604	49*	32*
Irregular shift	722	27*	12*E1
Women			
Regular daytime	3,252	85	76
Evening shift	168	37*	19*E2
Rotating shift	358	50*	27*
Irregular shift	483	30*	11*E1

Data source: *1994/95, 1996/97, 1998/99 National Population Health Survey, longitudinal sample, Health file*
Notes: *Based on 2,520 male and 2,357 female longitudinal respondents. Of the men, 1,786 worked daytime schedule, 98 evening shift , 301 rotating shift, and 335 irregular shift in 1994/95. For women, sample sizes were 1,772 for daytime schedule, 103 for evening shift, 241 for rotating shift, and 241 for irregular shift.*
† Excludes night shift workers
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.15 and 33.3%
F Coefficient of variation greater than 33.3%
** Significantly different from regular daytime ($p < 0.05$)*

Trends in working shift

Over the past decade, the percentage of Canadian workers with non-standard hours changed very little. According to the Survey of Work Arrangements (November 1991 and November 1995), the first three cycles of the National Population Health Survey (1994/95, 1996/97 and 1998/99), and the Canadian Community Health Survey (2000/01), the proportion of employed people reporting shift work remained relatively stable at approximately 30%.

Before 1990, little information was available about the percentage of workers with non-standard hours, and there are comparability problems with the limited data that do exist.[64] However, some historical evidence points to a rise in the prevalence of shift work in both Canada and the United States throughout the 1970s and 1980s because of growth of the service sector and dramatic increases in the proportion of students working during the school year.[48,64]

Percentage of workers with non-standard hours, by sex, workers aged 18 to 54, Canada excluding territories, selected years 1991 to 2000/01

	Men	Women
	%	
1991 Survey of Work Arrangements (November)	28	29
1994/95 National Population Health Survey	31	27
1995 Survey of Work Arrangements (November)	33	30
1996/97 National Population Health Survey	30	28
1998/99 National Population Health Survey	31	28
2000/01 Canadian Community Health Survey	31	28

Notes: *No significant differences in percentages for women across years; for men, rate for 1995 Survey of Work Arrangements exceeds rate for 1991 Survey of Work Arrangements ($p < 0.05$ adjusted for multiple comparisons).*

Concluding remarks

About 3 out of 10 Canadian workers are putting in non-standard hours. Most work shifts because their jobs require it, not because they choose to do so. With a few notable exceptions, shift work tends to be performed by younger, unmarried, less-educated and less affluent individuals.

According to the National Population Health Survey, shift workers face a number of potential psycho-social problems. In 1994/95, work stress was relatively common among shift workers: job strain for those who worked an evening or rotating shift; job insecurity for those who worked a rotating or irregular shift. Men who worked an evening shift in 1994/95 were more likely than those with a regular daytime schedule to report a low sense of mastery, and to have relationship problems. They were also

more likely to be daily smokers. For women, an irregular shift was related to high personal stress, and a rotating shift, to a low sense of mastery.

Even when work stress, personal stress, health behaviour, socio-economic status and other work-related factors were taken into account, men working an evening, rotating or irregular shift all had higher odds of reporting a diagnosis of a chronic condition sometime in the four years from 1994/95 to 1998/99 than did men with regular daytime schedules. For both sexes, working the evening shift in 1994/95 was associated with an increase in psychological distress by 1996/97. Thus, consistent with other research, analysis of NPHS data suggests a link between mental health and shift work.[25,27-30] The association, however, was significant longitudinally but not cross-sectionally.

The evening shift is especially problematic for men. Women's apparently greater ability to cope may be because they are more likely than men to work these schedules to care for family. In such cases, an evening shift may even help accommodate other priorities.

Given the problems experienced by shift workers, it is not surprising that most do not maintain non-standard hours for prolonged periods. Within two years, most shift workers either changed their hours or left the workforce. This supports earlier studies suggesting a "healthy survivor effect," meaning that the people who continue are a more robust group who are willing and able to tolerate the stress of working shift.[12,17,25,47]

References

1 Colligan MJ, Rosa RR. Shiftwork effects on social and family life. *Occupational Medicine* 1990; 5(2): 315-22.

2 Harrington JM. Shift work and health—a critical review of the literature on working hours. *Annals of the Academy of Medicine, Singapore* 1994; 23(5): 699-705.

3 Åkerstedt T. Sleepiness as a consequence of shift work. *Sleep* 1988; 11(1): 17-34.

4 Åkerstedt T. Psychological and psychophysiological effects of shift work. *Scandinavian Journal of Work, Environment and Health* 1990; 16 (Supplement 1): 67-73.

5 Brugère D, Barrit J, Butat C, et al. Shiftwork, age, and health: An epidemiologic investigation. *International Journal of Occupational and Environmental Health* 1997; 3(Supplement 2): S15-9.

6 Härmä M, Tenkanen L, Sjöblom T, et al. Combined effects of shift work and life-style on the prevalence of insomnia, sleep deprivation and daytime sleepiness. *Scandinavian Journal of Work, Environment and Health* 1998; 24(4): 300-7.

7 Niedhammer I, Lert F, Marne MJ. Effects of shift work on sleep among French nurses. A longitudinal study. *Journal of Occupational Medicine* 1994; 36(6): 667-74.

8 Parkes KR. Shiftwork, job type, and the work environment as joint predictors of health-related outcomes. *Journal of Occupational Health Psychology* 1999; 4(3): 256-68.

9 Tepas DI, Carvalhais AB. Sleep patterns of shiftworkers. *Occupational Medicine* 1990; 5(2): 199-208.

10 Bøggild H, Knutsson A. Shift work, risk factors and cardiovascular disease. *Scandinavian Journal of Work, Environment and Health* 1999; 25(2): 85-99.

11 Kawachi I, Colditz GA, Stampfer MJ, et al. Prospective study of shift work and risk of coronary heart disease in women. *Circulation* 1995; 92(11): 3178-82.

12 Knutsson A, Åkerstedt T, Jonsson BG, et al. Increased risk of ischaemic heart disease in shift workers. *Lancet* 1986; 2(8498): 89-92.

13 Knutsson A. Shift work and coronary heart disease. *Scandinavian Journal of Work, Environment and Health Supplementum* 1989; 44: 1-36.

14 Murata K, Yano E, Shinozaki T. Cardiovascular dysfunction due to shift work. *Journal of Occupational and Environmental Medicine* 1999; 41(9): 748-53.

15 Tenkanen L, Sjöblom T, Kalimo R, et al. Shift work, occupation and coronary heart disease over 6 years of follow-up in the Helsinki Heart Study. *Scandinavian Journal of Work, Environment and Health* 1997; 23(4): 257-65.

16 Tenkanen L, Sjöblom T, Härmä M. Joint effect of shift work and adverse life-style factors on the risk of coronary heart disease. *Scandinavian Journal of Work, Environment and Health* 1998; 24(5): 351-7.

17 Morikawa Y, Nakagawa H, Miura K, et al. Relationship between shift work and onset of hypertension in a cohort of manual workers. *Scandinavian Journal of Work, Environment and Health* 1999; 25(2): 100-4.

18 Segawa K, Nakazawa S, Tsukamoto Y, et al. Peptic ulcer is prevalent among shift workers. *Digestive Diseases and Sciences* 1987; 32(5): 449-53.

19 Tuchsen F, Jeppesen HJ, Bach E. Employment status, non-daytime work and gastric ulcer in men. *International Journal of Epidemiology* 1994; 23(2): 365-70.

20 Costa G. The problem: shiftwork. *Chronobiology International* 1997; 14(2): 89-98.

21 Nurminen T. Shift work and reproductive health. *Scandinavian Journal of Work, Environment and Health* 1998; 24(Supplement 3): 28-34.

22 Davis S, Mirick DK, Stevens RG. Night shift work, light at night, and risk of breast cancer. *Journal of the National Cancer Institute* 2001; 93(20): 1557-62.

23 Hansen J. Light at night, shiftwork, and breast cancer risk. *Journal of the National Cancer Institute* 2001; 93(20): 1513-5.

24 Scott AJ. Shift work and health. *Primary Care* 2000; 27(4): 1057-79.

25 Bohle P, Tilley AJ. The impact of night work on psychological well-being. *Ergonomics* 1989; 32(9): 1089-99.

26 Gordon NP, Cleary PD, Parker CE, et al. The prevalence and health impact of shiftwork. *American Journal of Public Health* 1986; 76(10): 1225-8.

27 Healy D, Minors DS, Waterhouse JM. Shiftwork, helplessness and depression. *Journal of Affective Disorders* 1993; 29(1): 17-25.

28 Puca FM, Perrucci S, Prudenzano MP, et al. Quality of life in shift work syndrome. *Functional Neurology* 1996; 11(5): 261-8.

29 Scott AJ, Monk TH, Brink LL. Shiftwork as a risk factor for depression: A pilot study. *International Journal of Occupational and Environmental Health* 1997; 3(Supplement 2): S2-9.

30 Smith CS, Robie C, Folkard S, et al. A process model of shiftwork and health. *Journal of Occupational Health Psychology* 1999; 4(3): 207-18.

31 Béland Y. Canadian Community Health Survey—Methodological overview. *Health Reports* (Statistics Canada, Catalogue 82-003) 2002; 13(3): 9-14.

32 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.

33 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.

34 Scott AJ, LaDou J. Shiftwork: effects on sleep and health with recommendations for medical surveillance and screening. *Occupational Medicine* 1990; 5(2): 273-99.

35 Cole RJ, Loving RT, Kripke DF. Psychiatric aspects of shiftwork. *Occupational Medicine* 1990; 5(2): 301-14.

36 Knutsson A, Åkerstedt T, Jonsson BG. Prevalence of risk factors for coronary artery disease among day and shift workers. *Scandinavian Journal of Work, Environment and Health* 1988; 14(5): 317-21.

37 Olsson K, Kandolin I, Kauppinen-Toropainen K. Stress and coping strategies of three-shift workers. *Le Travail Humain* 1990; 53(2): 175-88.

38 Taylor E, Briner RB, Folkard S. Models of shiftwork and health: an examination of the influence of stress on shiftwork theory. *Human Factors* 1997; 39(1): 67-82.

39 Cohen S, Herbert TB. Health psychology: Psychological factors and physical disease from the perspective of human psychoneuroimmunology. *Annual Review of Psychology* 1996; 47: 113-42.

40 Cohen S, Tyrrell DA, Smith AP. Psychological stress and susceptibility to the common cold. *The New England Journal of Medicine* 1991; 325(9): 606-12.

41 Koehler T. Stress and rheumatoid arthritis: A survey of empirical evidence in human and animal studies. *The Journal of Psychosomatic Research* 1985; 29(6): 655-63.

42 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.

43 Rust K, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5: 281-310.

44 Yeo D, Mantel H, Liu TP. Bootstrap variance estimation for the National Population Health Survey. *American Statistical Association: Proceedings of the Survey Research Methods Section*. Baltimore, August 1999.

45 Härmä M. Ageing, physical fitness and shiftwork tolerance. *Applied Ergonomics* 1996; 27(1): 25-9.

46 Glazner LK. Shiftwork: its effect on workers. *AAOHN Journal* 1991; 39(9): 416-21.

47 Härmä M. Individual differences in tolerance to shiftwork: a review. *Ergonomics* 1993; 36(1-3): 101-9.

48 Presser HB. Job, family, and gender: determinants of nonstandard work schedules among employed Americans in 1991. *Demography* 1995; 32(4): 577-98.

49 Bosma H, Marmot MG, Hemingway H, et al. Low job control and risk of coronary heart disease in Whitehall II (prospective cohort) study. *British Medical Journal* 1997; 314(7080): 558-65.

50 Bourbonnais R, Brisson C, Moisan J, et al. Job strain and psychological distress in white-collar workers. *Scandinavian Journal of Work, Environment and Health* 1996; 22(2): 139-45.

51 Braun S, Hollander RB. Work and depression among women in the Federal Republic of Germany. *Women and Health* 1988; 14(2): 3-26.

52 Karasek RA, Baker D, Marxer F, et al. Job decision latitude, job demands, and cardiovascular disease: a prospective study of Swedish men. *American Journal of Public Health* 1981; 71(7): 694-705.

53 Karasek RA. Job demands, job decision latitude, and mental strain: Implications for job redesign. *Administrative Science Quarterly* 1979; 24: 285-308.

54 Light KC, Turner JR, Hinderliter AL. Job strain and ambulatory work blood pressure in healthy young men and women. *Hypertension* 1992; 20(2): 214-8.

55 Statistics Canada. Stress and well-being. In: *The Health Divide—How the Sexes Differ. Health Reports* special issue (Statistics Canada, Catalogue 82-003) 2001; 12(3): 21-32.

56 Wilkins K, Beaudet MP. Work stress and health. *Health Reports* (Statistics Canada, Catalogue 82-003) 1998; 10(3): 47-62.

57 Statistics Canada. Appendix F: Derived variables. *National Population Health Survey: 1994-95 Public Use Microdata File* (Catalogue 82F0001XCB) Ottawa: Minister of Industry, 1995: 17-20.

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

59 Ogińska H, Pokorski J, Ogińska A. Gender, ageing, and shiftwork intolerance. *Ergonomics* 1993; 36(1-3): 161-8.

60 Shields M. Proxy reporting in the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 2000; 12(1): 21-39.

61 Henson R, Roth A, Cannell CF. Personal versus telephone interviews: the effects of telephone reinterviews on reporting of psychiatric symptomatology. In: *National Center for Health Services Research Report Series: Field Experiments in Health Reporting, 1971-1977*. Ann Arbor, Michigan: University of Michigan, Survey Research Center, Institute for Social Research, 1977: 205-12.

62 Aneshensel CS, Yokopenic PA. Tests for the comparability of a causal model of depression under two conditions of interviewing. *Journal of Personality and Social Psychology* 1985; 49(5): 1337-48.

63 Wells KB, Burnam MA, Leake B, et al. Agreement between face-to-face and telephone-administered versions of the depression section of the NIMH Diagnostic Interview Schedule. *Journal of Psychiatric Research* 1988; 22(3): 207-20.

64 Sunter D. Working shift. *Perspectives on Labour and Income* (Statistics Canada, Catalogue 75-001) 1993; 5(1): 16-23.

Appendix

Table A
Distribution of chronic condition prevalence and incidence, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

	Men			Women		
	Sample size	Estimated population		Sample size	Estimated population	
		'000	%		'000	%
Total - 1994/95 cross-sectional file	3,583	5,524	100.0	3,273	4,369	100.0
Chronic condition(s) in 1994/95						
None	2,480	3,867	70.0	2,069	2,880	65.9
One or more	1,099	1,651	29.9	1,201	1,487	34.0
Missing	4	F	F	3	F	F
Total - longitudinal file	2,520	5,448	100.0	2,357	4,269	100.0
Chronic condition(s) diagnosed between 1994/95 and 1998/99						
None	1,970	4,249	78.0	1,724	3,163	74.1
One or more	543	1,184	21.7	626	1,089	25.5
Missing	7	F	F	7	F	F

Data source: *1994/95 National Population Health Survey, cross-sectional sample, Health file; 1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*
Note: *Because of rounding, detail may not add to totals.*
F Coefficient of variation greater than 33.3%

Table B
Average psychological distress scores, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories

	Sample responding	Missing	Weighted average
Men			
Distress score 1994/95	3,350	233	2.9
Difference in scores			
Between 1994/95 and 1998/99	2,324	196	-0.6
Between 1994/95 and 1996/97	2,325	195	-0.6
Women			
Distress score 1994/95	3,214	59	3.4
Difference in scores			
Between 1994/95 and 1998/99	2,312	45	-0.7
Between 1994/95 and 1996/97	2,308	49	-0.7

Data source: *1994/95 National Population Health Survey, cross-sectional sample, Health file; 1994/95, 1996/97 and 1998/99 National Population Health Survey, longitudinal sample, Health file*

Table C
Distribution of selected characteristics, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories, National Population Health Survey, cross-sectional sample, Health file, 1994/95

	Men			Women		
	Sample size	Estimated population		Sample size	Estimated population	
		'000	%		'000	%
Total	**3,583**	**5,524**	**100.0**	**3,273**	**4,369**	**100.0**
Work schedule†						
Regular daytime	2,507	3,933	71.2	2,431	3,298	75.5
Evening shift	137	261	4.7	149	187	4.3
Rotating shift	465	618	11.2	335	372	8.5
Irregular shift	471	711	12.9	356	509	11.7
Missing	3	F	F	2	F	F
Occupation						
White-collar	1,086	1,732	31.4	1,286	1,676	38.4
Clerical	173	334	6.0	825	1,118	25.6
Sales/Service	561	895	16.2	725	941	21.5
Blue-collar	1,587	2,276	41.2	242	370	8.5
Missing	176	286	5.2	195	263	6.0
Weekly work hours						
1-29	217	401	7.3	708	1,005	23.0
30-40	1,681	2,629	47.6	1,908	2,529	57.9
More than 40	1,669	2,470	44.7	653	831	19.0
Missing	16	F	F	4	F	F
Weekend worker						
Yes	1,561	2,321	42.0	1,206	1,476	33.8
No	2,019	3,201	58.0	2,065	2,890	66.2
Missing	3	F	F	2	F	F
Self-employed						
Yes	607	961	17.4	296	422	9.7
No	2,897	4,455	80.6	2,873	3,811	87.2
Missing	79	109	2.0	104	136	3.1
Age group						
18-24	362	519	9.4	374	479	11.0
25-34	1,120	1,684	30.5	1,058	1,375	31.5
35-44	1,183	1,887	34.2	1,062	1,499	34.3
45-54	918	1,435	26.0	779	1,015	23.2
Married						
Yes	2,434	4,054	73.4	2,108	3,045	69.7
No	1,149	1,470	26.6	1,164	1,321	30.2
Missing	0	0	0	1	F	F
Child(ren) under age 12 in household						
Yes	1,193	2,147	38.9	1,102	1,614	37.0
No	2,390	3,377	61.1	2,171	2,755	63.0
Education						
Less than postsecondary graduation	2,172	3,231	58.5	1,881	2,482	56.8
Postsecondary graduation	1,406	2,285	41.4	1,389	1,884	43.1
Missing	5	F	F	3	F	F
Household income						
Lower	1,086	1,596	28.9	1,118	1,354	31.0
Higher	2,361	3,668	66.4	2,053	2,865	65.6
Missing	136	260	4.7	102	151	3.4
High job strain						
Yes	620	910	16.5	973	1,255	28.7
No	2,604	3,845	69.6	2,101	2,758	63.1
Missing	359	769	13.9	199	356	8.1
High physical demands						
Yes	1,632	2,317	41.9	1,274	1,603	36.7
No	1,592	2,439	44.1	1,800	2,411	55.2
Missing	359	769	13.9	199	356	8.1
Low supervisor support						
Yes	577	906	16.4	495	681	15.6
No	2,647	3,850	69.7	2,579	3,332	76.3
Missing	359	769	13.9	199	356	8.1
Low co-worker support						
Yes	1,012	1,518	27.5	1,071	1,445	33.1
No	2,212	3,237	58.6	2,003	2,568	58.8
Missing	359	769	13.9	199	356	8.1
High job insecurity						
Yes	569	901	16.3	631	807	18.5
No	2,655	3,855	69.8	2,443	3,206	73.4
Missing	359	769	13.9	199	356	8.1
High personal stress						
Yes	1,104	1,714	31.0	1,367	1,889	43.2
No	2,245	3,387	61.3	1,843	2,393	54.8
Missing	234	423	7.7	63	87	2.0
Relationship problems						
Yes	801	1,166	21.1	823	1,081	24.7
No	2,557	3,960	71.7	2,396	3,215	73.6
Missing	225	398	7.2	54	73	1.7
Low mastery						
Yes	684	1,030	18.6	764	1,019	23.3
No	2,666	4,092	74.1	2,445	3,253	74.4
Missing	233	403	7.3	64	98	2.2
Daily smoker						
Yes	1,067	1,587	28.7	832	1,067	24.4
No	2,515	3,933	71.2	2,441	3,302	75.6
Missing	1	F	F	0	0	0
Inactive						
Yes	1,928	2,935	53.1	2,007	2,800	64.1
No	1,445	2,221	40.2	1,218	1,505	34.4
Missing	210	368	6.7	48	65[E1]	1.5[E1]
Heavy drinker						
Yes	898	1,154	20.9	222	254	5.8
No	2,610	4,266	77.2	3,011	4,057	92.9
Missing	75	104	1.9	40	57[E1]	1.3[E1]
Obese						
Yes	499	665	12.0	377	454	10.4
No	2,992	4,667	84.5	2,680	3,611	82.7
Missing/Not applicable	92	192	3.5	216	304	7.0

Notes: *Because of rounding, detail may not add to totals. Questions on job strain, physical demands, supervisor and co-worker support, job insecurity, personal stress, relationship problems, mastery, and physical activity were not asked of proxy respondents; therefore, percentage of missing values for these variables is higher. A problem with computer-assisted interview in third quarter 1994/95 data collection resulted in French-language respondents being bypassed for questions on work stress, which further increased missing values for these variables.*

† Excludes night shift workers

E1 Coefficient of variation between 16.6% and 25.0%

F Coefficient of variation greater than 33.3%

Table D

Distribution of selected characteristics, by sex, workers aged 18 to 54 employed throughout 1994/95, Canada excluding territories, 1994/95, 1996/97, 1998/99 National Population Health Survey, longitudinal sample, Health file

	Men			Women		
	Sample size	Estimated population		Sample size	Estimated population	
		'000	%		'000	%
Total	**2,520**	**5,448**	**100.0**	**2,357**	**4,269**	**100.0**
Work schedule†						
Regular daytime	1,786	3,863	70.9	1,772	3,258	76.3
Evening shift	98	259	4.8	103	168	3.9
Rotating shift	301	604	11.1	241	359	8.4
Irregular shfit	335	722	13.2	241	484	11.3
Occupation						
White-collar	771	1,675	30.7	944	1,682	39.4
Clerical	133	323	5.9	613	1,083	25.4
Sales/Service	393	918	16.8	507	917	21.5
Blue-collar	1,106	2,270	41.7	171	365	8.6
Missing	117	263	4.8	122	222	5.2
Weekly work hours						
1-29	145	379	7.0	511	1,004	23.5
30-40	1,198	2,642	48.5	1,383	2,455	57.5
More than 40	1,167	2,401	44.1	460	805	18.9
Missing	10	F	F	3	F	F
Weekend worker						
Yes	1,069	2,267	41.6	833	1,408	33.0
No	1,451	3,181	58.4	1,524	2,861	67.0
Self-employed						
Yes	433	926	17.0	203	395	9.3
No	2,035	4,412	81.0	2,087	3,758	88.0
Missing	52	111[E1]	2.0[E1]	67	116[E1]	2.7[E1]
Age group						
18-24	262	547	10.0	257	449	10.5
25-34	770	1,636	30.0	745	1,317	30.9
35-44	830	1,892	34.7	786	1,533	35.9
45-54	658	1,373	25.2	569	969	22.7
Married						
Yes	1,721	4,003	73.5	1,525	3,040	71.2
No	799	1,445	26.5	832	1,229	28.8
Child(ren) under age 12 in household						
Yes	849	2,186	40.1	821	1,657	38.8
No	1,671	3,262	59.9	1,536	2,612	61.2
Education						
Less than postsecondary graduation	1,512	3,209	58.9	1,323	2,410	56.4
Postsecondary graduation	1,004	2,230	40.9	1,031	1,854	43.4
Missing	4	F	F	3	F	F
Household income						
Lower	759	1,543	28.3	805	1,332	31.2
Higher	1,659	3,648	67.0	1,480	2,790	65.4
Missing	102	257	4.7	72	147	3.4
High job strain						
Yes	427	914	16.8	692	1,210	28.4
No	1,820	3,800	69.8	1,518	2,719	63.7
Missing	273	733	13.5	147	340	8.0
High physical demands						
Yes	1,137	2,315	42.5	890	1,543	36.2
No	1,110	2,399	44.0	1,320	2,386	55.9
Missing	273	733	13.5	147	340	8.0
Low supervisor support						
Yes	398	870	16.0	362	672	15.7
No	1,849	3,845	70.6	1,848	3,258	76.3
Missing	273	733	13.5	147	340	8.0
Low co-worker support						
Yes	698	1,540	28.3	770	1,425	33.4
No	1,549	3,175	58.3	1,440	2,505	58.7
Missing	273	733	13.5	147	340	8.0
High job insecurity						
Yes	386	860	15.8	458	802	18.8
No	1,861	3,854	70.7	1,752	3,128	73.3
Missing	273	733	13.5	147	340	8.0
High personal stress						
Yes	735	1,657	30.4	978	1,858	43.5
No	1,615	3,389	62.2	1,341	2,342	54.9
Missing	170	402	7.4	38	69[E1]	1.6[E1]
Relationship problems						
Yes	552	1,169	21.4	590	1,068	25.0
No	1,806	3,891	71.4	1,735	3,147	73.7
Missing	162	388	7.1	32	54[E1]	1.3[E1]
Low mastery						
Yes	462	999	18.3	562	1,006	23.6
No	1,893	4,061	74.5	1,760	3,187	74.6
Missing	165	388	7.1	35	77[E1]	1.8[E1]
Daily smoker						
Yes	735	1,490	27.3	589	1,045	24.5
No	1,784	3,953	72.6	1,768	3,224	75.5
Missing	1	F	F	0	0	0
Inactive						
Yes	1,358	2,914	53.5	1,480	2,794	65.5
No	1,008	2,172	39.9	850	1,429	33.5
Missing	154	362	6.6	27	46[E1]	1.1[E1]
Heavy drinker						
Yes	611	1,120	20.6	146	232	5.4
No	1,858	4,232	77.7	2,184	3,984	93.3
Missing	51	96[E1]	1.8[E1]	27	52[E1]	1.2[E1]
Obese						
Yes	335	674	12.4	283	448	10.5
No	2,117	4,558	83.7	1,928	3,552	83.2
Missing/Not applicable	68	216[E1]	4.0	146	270	6.3

Notes: *Because of rounding, detail may not add to totals. Questions on job strain, physical demands, supervisor and co-worker support, job insecurity, personal stress, relationship problems, mastery, and physical activity were not asked of proxy respondents; therefore, percentage of missing values for these variables is higher. A problem with computer-assisted interview in third quarter 1994/95 data collection resulted in French-language respondents being bypassed for questions on work stress, which further increased missing values for these variables.*

† Excludes night shift workers

E1 Coefficient of variation between 16.6% and 25.0%

F Coefficient of variation greater than 33.3%

Loss and recovery of independence among seniors

Laurent Martel, Alain Bélanger and Jean-Marie Berthelot

Abstract

Objectives

This article identifies risk factors associated with the loss and recovery of independence among the household population aged 65 or older.

Data sources

The data are from the longitudinal component of the first two cycles (1994/95 and 1996/97) of Statistics Canada's National Population Health Survey (NPHS). Supplementary information is from the cross-sectional component of the 1998/99 NPHS.

Analytical techniques

Cross-tabulations were used to estimate the proportions of seniors who lost or regained independence between 1994/95 and 1996/97. Logistic regression models were used to explore associations between loss or recovery of independence and demographic, behavioural and socio-economic variables, as well as chronic conditions.

Main results

Age, sex and the effects of stroke were significantly related to the loss and recovery of independence among seniors. Bronchitis/emphysema, diabetes, heart disease, weight, physical activity, education and household income were associated with the loss of independence, but not its recovery. Dependent seniors with back problems, urinary incontinence, or who smoked had low odds of regaining independence.

Key words

independent living, activities of daily living, instrumental activities of daily living, limitation of activity

Authors

Laurent Martel (613-951-2352; laurent.martel@statcan.ca) and Alain Bélanger (613-951-2326; alain.belanger@statcan.ca) are with the Demography Division, and Jean-Marie Berthelot (613-951-3760; jean-marie.berthelot@statcan.ca) is with the Health Analysis and Measurement Group at Statistics Canada, Ottawa, Ontario K1A 0T6.

Statistics Canada's most recent projections indicate that the proportion of seniors in the population will double by 2031.[1] There are nearly 4 million people aged 65 or older in Canada today, but in 30 years, according to the medium-growth scenario, there will be 8.7 million—2.3 million of whom will be at least 80 years old. Age is strongly associated with the onset of chronic conditions, activity limitations, disabilities, and institutionalization. Therefore, it is expected that this growth in the elderly population will exert increasing pressure on the health care system.[2]

Policies designed to meet the challenges of an aging population (for instance, prolonging independence) must be based on understanding of the disability process in old age. Most of the abundant literature on the subject deals with the prevalence of disability and the factors associated with it.[3] But the prevalence of disability results from events—entries into and exits from disability-related states—that occurred in the past, while the explanatory variables used in many studies were measured at the same time as the outcome.

Methods

Data source

The National Population Health Survey (NPHS), which began in 1994/95, collects detailed information about the heath of Canadians every two years. Only persons living on Indian reserves, on Canadian Forces bases, and in some remote areas are excluded. The NPHS has cross-sectional and longitudinal components.

NPHS data are stored in two files. The General file contains socio-demographic and some health information obtained for each member of participating households. The Health file contains in-depth health information, which was collected for one randomly selected household member, as well as the information in the General file pertaining to that individual.

Of the 17,626 randomly selected respondents in 1994/95, 14,786 were eligible members of the longitudinal panel, along with 468 persons for whom general information was collected. An additional 2,022 of the 2,383 randomly selected respondents younger than 12 were eligible for the longitudinal panel. Thus, 17,276 respondents were eligible for re-interview in 1996/97. A response rate of 93.6% was achieved. Of the 16,168 participants in 1996/97, full information (that is, general and in-depth health information for the two cycles or an outcome of death or institutionalization) was available for 15,670. More detailed descriptions of the NPHS design, sample, and interview procedures can be found in published reports.[4,5]

The longitudinal sample analyzed for this article consists of 2,546 respondents aged 65 or older living in private households in 1994/95. Of these respondents, 2,028 were independent in 1994/95, and 518 were dependent.

The independent group (those "at risk" of becoming dependent) in this analysis was identified by subtracting the 88 deaths that occurred between 1994/95 and 1996/97. (The group at risk of losing their independence was, therefore, conditional upon survival between the two NPHS cycles.) Another 19 cases were excluded because of missing values for variables used to define the functional health states. This left 1,921 respondents at risk of loss of independence over the two-year period.

The dependent group, who potentially could recover their independence, was identified by subtracting the 113 deaths that occurred by 1996/97 and 6 cases for which there were missing values from the 518 dependent seniors residing in private households in 1994/95. This yielded 399 respondents in private households who could potentially recover their independence (Appendix Table A).

Residents of long-term health care institutions at both dates were, by definition, dependent and were not included in the analysis. As well, the very few (n=5) seniors who moved from health care institutions to private households between 1994/95 and 1996/97 were regarded as still being dependent and were excluded from the analysis, because detailed information on them is not available (Appendix, Chart A).

The analysis is supplemented by cross-sectional data from the household component of the 1998/99 NPHS on the percentage of seniors who needed help with each of the activities on which the definition of dependence is based. The overall response rate for 1998/99 was 88.2%. The data were weighted to represent the household population in the 10 provinces. The sub-sample for this analysis consisted of 2,851 people aged 65 or older.

Analytical techniques

Respondents were asked if, because of a long-term health problem, they needed another person to help them perform activities of daily living (ADL) and instrumental activities of daily living (IADL): personal care such as washing, dressing or eating, moving about inside the house, meal preparation, shopping for groceries or other necessities, everyday housework, and heavy household chores. Respondents who were "independent" did not report needing help with any of these activities or needed help with heavy household chores only. The "dependent" category comprised people who needed help with at least one of these tasks (except heavy housework).

Between 1994/95 and 1996/97, there were 283 transitions of seniors between independence and dependence and 138 transitions in the other direction (Appendix, Chart A). People admitted to a long-term health care institution between 1994/95 and 1996/97 were considered to have experienced a loss of independence; specifically, the 28 respondents who were independent in 1994/95 but who were residing in a long-term health care facility in 1996/97 were added to the 255 persons living in private households who were independent in 1994/95 and had become dependent by 1996/97. The 29 household residents who were dependent in 1994/95 and were residing in a health care facility two years later were considered to be dependent at both dates.

Cross-tabulations based on the longitudinal file were used to estimate the proportions of household-dwelling seniors who became dependent or independent between 1994/95 and 1996/97, by sex, age, living arrangements, chronic conditions, body mass index, physical activity, smoking status, alcohol consumption, education, household income, and urban/rural residence. Logistic regression models were used to explore the relationship between the loss or recovery of independence and the chosen set of demographic, socio-economic and behavioural factors, as well as chronic conditions (see *Definitions*). Using the same independent variables, separate regressions were fitted to assess the effect of each factor on the loss or recovery of independence. Thus, the results of the two regressions can be compared.

Estimates were weighted to represent Canada's senior population in 1994/95. To account for survey design effects, standard errors and coefficients of variation were estimated with the bootstrap technique.[6-8]

However, results from some American surveys—notably the Longitudinal Survey on Aging, the National Long-term Care Survey, and the Health and Retirement Survey—have shown the dynamic nature of functional health. For example, some individuals, even quite elderly ones, recover their independence after an episode of dependence.[9-18]

In 1994/95, Statistics Canada launched the National Population Health Survey (NPHS), which includes a longitudinal panel. Because it can be used to trace transitions between functional health states, and also because it contains information on a wide range of health-related characteristics, this survey opened the door to studies of factors that predispose people to lose or recover functional health.[19,20] An analysis based on flows between functional states in a longitudinal perspective permits the measurement of health determinants before transitions, as well as an examination of factors associated with the loss and recovery of independence. With longitudinal data from the NPHS, this article identifies some of the statistically significant risk factors associated with the loss and recovery of independence among the elderly in Canada between 1994/95 and 1996/97 (see *Methods, Definitions* and *Limitations*).

The ability to detect transitions between independence and dependence may vary with the duration of the period under examination.[21] It has been estimated that episodes of dependence last an average of 18 months for a moderate impairment and 23 months for a severe impairment.[22] If functional status at the beginning and end of a long period (for example, four or more years) is compared, many intermediate transitions between independence and dependence might be missed. Consequently, only the first two NPHS cycles, 1994/95 and 1996/97, are used in this analysis. Moreover, using the first two cycles is judicious, since the longitudinal panel was representative of the Canadian population only in 1994/95. As a result, this article differs from a previous analysis of functional transitions based on the NPHS.[20]

Conceptual framework

Given the many determinants of functional health, developing a conceptual framework to analyze the loss and recovery of independence among seniors is a major challenge. Nevertheless, understanding of the processes has grown substantially over the past three decades. The framework proposed for this analysis draws on the works of Anderson et al.,[23] Evans and Stoddard[24] and Verbrugge and Jetté,[25] and also takes into account the population-health approach developed by Health Canada.[3] Five major categories of factors thought to affect functional health are examined: demographic variables, chronic conditions, behavioural factors, socio-economic variables, and area of residence.

Three demographic variables are included in this analysis: sex, age and living arrangements. Studies of transitions between functional states stress the close link between age and loss of independence.[12,15,16]

Results of cross-sectional studies have shown a higher prevalence of disabilities among women than men, primarily because of women's greater propensity to develop disabling chronic diseases. However, the association between sex and independence is less consistent: some research has found an association;[12,17,20,26] other studies, controlling for death and institutionalization, have not.[15,16,27]

Living arrangements are closely correlated with marital status, which has been shown to be significantly associated with institutionalization.[28,29] However, while some researchers found no association between loss of independence and marital status,[26] others found that married people were most likely to recover their independence after an episode of dependence,[12] which implies that a spouse may be instrumental in this process. Also, unmarried people were at a greater risk than married people of losing their independence.

As might be expected, some chronic diseases can affect independence. They may, in fact, be more important than age, suggesting that independence is primarily a matter of health, not age.[15] This analysis controls for: asthma, arthritis, back problems, bronchitis/emphysema, diabetes, heart disease, cancer, stroke, urinary incontinence, and glaucoma/cataracts.

Four lifestyle-related factors are considered: weight as measured by body mass index (BMI), physical activity, smoking, and alcohol consumption. Body mass index (BMI) was included in the model because of the harmful health effects of overweight and obesity.[3,30-35] Although links between obesity and independence remain largely unexplored, obesity among older people has recently been shown to be associated with activity limitations, especially in terms of mobility and chronic diseases.[33]

Physical activity is associated with both physical and mental health.[19,40] It is also known that inactivity is a significant risk factor for coronary heart disease and other serious health problems.[3]

Definitions

Respondents to the National Population Health Survey were asked if, because of a long-term health problem, they needed another person to help them perform certain tasks, based on instrumental activities of daily living (IADL)[36] and activities of daily living (ADL)[37]: "Because of any condition or health problem, do you need the help of another person in: a) preparing meals? b) shopping for groceries or other necessities? c) doing normal everyday household work? d) doing heavy household chores such as washing walls or yardwork? e) personal care such as washing, dressing or eating? f) moving about inside the house?" To be included in the *independent* category, a respondent had to have no dependency or to report being dependent only for heavy household chores. Respondents were classified as *dependent* if they needed help in preparing meals and/or shopping and/or daily household tasks and/or getting around the house and/or personal care.

Five *age groups* (as of 1994/95) were used in this analysis: 65 to 69, 70 to 74, 75 to 79, 80 to 84, and 85 or older.

Living arrangements were defined to reflect three situations: living with spouse, regardless of whether other people also lived in the household; living alone; and living with others, but not a spouse.

To determine the presence of *chronic conditions,* respondents were asked if they had "any long-term health conditions that have lasted or are expected to last six months or more that have been diagnosed by a health professional." A checklist of conditions was read; the following were considered in this analysis: asthma, arthritis or rheumatism, back problems (excluding arthritis), bronchitis/emphysema, diabetes, heart disease, cancer, the effects of stroke, urinary incontinence, and glaucoma/cataracts.

Body mass index (BMI), which was calculated by dividing weight in kilograms by the square of height in metres, was grouped into four categories for this analysis: underweight (a BMI of 18.5 or less), acceptable weight (more than 18.5 and less than 25), overweight/obese (25 or more), and missing. The "missing" category was necessary to retain as many cases as possible in the multivariate analysis. The BMI ranges are those of the World Health Organization[38] and differ from the Canadian standards.[39]

Physical activity refers to activity during leisure time. Frequency of physical activity was based on the number of times in the previous three months that respondents had participated in a physical activity for at least 15 minutes. Respondents were classified as active (at least four times per month) and inactive (less than four times per month).

Smoking was derived from responses to the following questions: "At what age did you stop smoking (cigarettes) daily?", "At the present time, do you smoke cigarettes daily, occasionally or not at all?" and "Have you ever smoked cigarettes at all?" For this analysis, respondents were divided into two categories: smoker (daily smoker, occasional but former daily smoker, and former daily smoker who had quit within the year) and non-smoker (always occasional smoker, former daily smoker who had quit for at least a year, former occasional smoker, and never smoked).

To establish *alcohol consumption* in 1994/95, respondents were asked, "During the past 12 months, how often did you drink alcoholic beverages?" Individuals were classified into two groups: regular drinker (at least 14 drinks a week) and occasional or non-drinker (fewer than 14 drinks a week or does not drink).

Respondents were grouped into two *education* categories based on the highest level attained as of 1994/95: less than postsecondary graduation and postsecondary graduation or more.

Household income was defined based on the number of people in the household and total household income from all sources in the 12 months before the 1994/95 interview.

Household income group	People in household	Total household income
Low	1 or 2	Less than $15,000
	3 or 4	Less than $20,000
	5 or more	Less than $30,000
Medium/High	1 or 2	$15,000 or more
	3 or 4	$20,000 or more
	5 or more	$30,000 or more

Residence was defined as rural or urban. Urban refers to a continuously inhabited area of at least 1,000 inhabitants and a population density of at least 400 per square kilometre.

Unlike its association with mortality, the impact of smoking on the loss of independence has received little attention, although some studies have shown that smoking not only reduces life expectancy, but also increases the burden of disability.[41,42]

Alcohol consumption has not been given special attention as a risk factor for changes in functional health status. However, moderate alcohol consumption has been shown to have beneficial health effects, especially with respect to the heart.[43,44]

The model includes two socio-economic variables: education and household income. Less-educated and lower-income individuals are generally in worse health and are more likely to die prematurely than better-educated and more affluent people.[3] Education, in particular, is related to lifestyles that may prevent or delay the onset of disease or disability.[45] As well, people with less education have been found to be more at risk of losing their independence.[12]

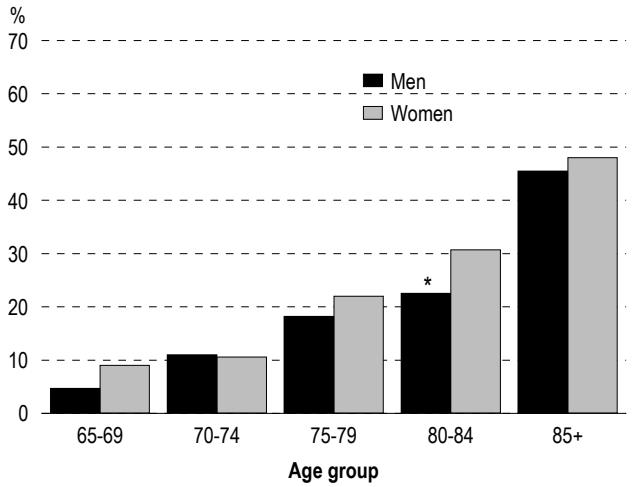
Finally, the model uses area of residence as a proxy for access to health care. Seniors in rural areas are distinguished from those in urban areas on the assumption that the latter have greater access to health services, and that this might be related to their ability to live independently.

Independence declines with age

Of the 2.5 million seniors who were independent and living in private households in 1994/95, 14% (an estimated 348,800 individuals) were found to be dependent in 1996/97. That is, by 1996/97, they needed the help of another person in performing at least one of the following activities: meal preparation, shopping for necessities, everyday housework, personal care (washing, dressing, bathing), and moving about inside their home (see *Needing help in 1998/99*). During the same period, 32% of seniors who had been dependent in 1994/95 recovered their independence, totalling an estimated 140,900 individuals.

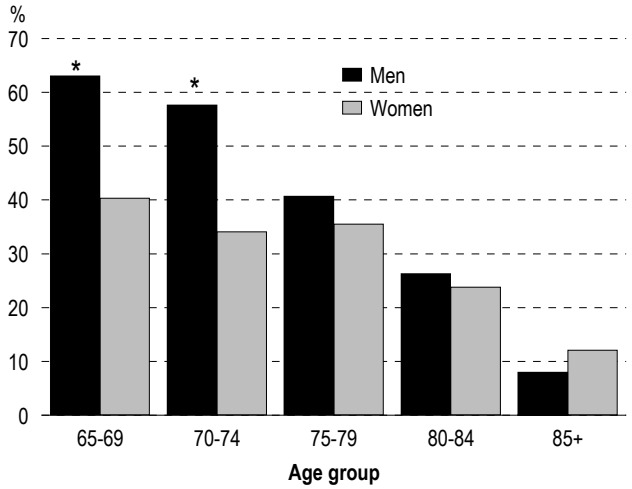
For both sexes, in fact, the likelihood of becoming dependent tended to rise with age (Chart 1, Table 1). Close to half of independent seniors aged 85 or older in 1994/95 were dependent two years later. By contrast, just 7% of independent people aged

Chart 1
Percentage of seniors who were independent in 1994/95 but dependent in 1996/97, by sex and age group, household population† aged 65 or older, Canada excluding territories



Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*
Note: *For both sexes, the percentages who were independent in 1994/95 but dependent in 1996/97 were significantly higher at ages 75 to 79, 80 to 84 and 85 or older than at ages 65 to 69 ($p \leq 0.05$).*
† Includes individuals who were independent in 1994/95, but were residing in a health care institution in 1996/97.
** Significantly lower than value for women ($p \leq 0.05$)*

Chart 2
Percentage of seniors who were dependent in 1994/95 but independent in 1996/97, by sex and age group, household population aged 65 or older, Canada excluding territories



Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*
Note: *For both sexes, the percentages who were dependent in 1994/95 but independent in 1996/97 were significantly higher at ages 65 to 69 than at 85 or older ($p \leq 0.05$).*
** Significantly higher than value for women ($p \leq 0.05$)*

65 to 69 in 1994/95 were found to be dependent in 1996/97.

The probability of regaining independence after it was lost tended to decrease with age. As well, among dependent seniors younger than 75 in 1994/95, men were significantly more likely than women to regain their independence (Chart 2). By age 75, however, differences between the sexes in the percentages recovering their independence faded.

These descriptive figures suggest an association between age and the loss or recovery of independence. But a number of other characteristics that tend to be common at older ages may actually be the deciding factors in these transitions. For instance, at older ages, the likelihood of living alone is greater. As well, the prevalence of chronic disease tends to increase with age. And having a chronic disease may preclude physical activity, which could affect weight. To identify characteristics that are

Needing help in 1998/99

According to the National Population Health Survey, most of the 3.5 million seniors living in private households in 1998/99 were independent; only a minority needed help with their daily activities. The likelihood of requiring assistance varied with the activity, and generally rose with advancing age.

The tasks with which seniors, especially women, were most likely to need help involved heavy housework. Overall, 28% of elderly men and 43% of elderly women required assistance with these activities. For both sexes, the percentages tended to rise with age, so that at 85 or older, 49% of men and 78% of women needed help with heavy chores. In all age groups, a higher percentage of women than men required such help.

Senior women were also more likely than senior men to require help with everyday housework: 18% versus 13%. However, the disparity reflected the situation among people in their seventies. By ages 80 to 84, there was no significant difference.

The pattern was similar for shopping for necessities. Whereas 16% of senior women needed such assistance, the percentage for senior men was 12%. This overall gap was largely attributable to people in their late seventies. By age 85, 48% of both men and women required help with shopping.

Just 8% of senior women and 11% of men needed help preparing meals. The percentages tended to rise with age, but differences between men and women were not statistically significant.

Relatively few seniors in private households needed help with personal care (washing, dressing, bathing) or moving about inside their homes. Overall, about 6% of seniors in households required help with personal care, and 6% of men and 3% of women needed help moving about at home. These low percentages reflect the fact that elderly people requiring such basic care generally live in institutions.[29] The need for such aid tended to become more common at older ages, and differences between the sexes were generally not statistically significant.

Percentage of population needing help with selected activities, by sex and age group, household population aged 65 or older, Canada excluding territories, 1998/99

	Heavy housework		Everyday housework		Shopping for necessities		Meal preparation		Personal care		Moving about at home	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
	%		%		%		%		%		%	
Total 65+	**27.8**	**43.3***	**13.1**	**18.2***	**11.9**	**16.4***	**11.0**	**7.5**	**6.0**	**6.2**	**5.5[E1]**	**3.3**
65-69	18.2	25.9*	5.9[E2]	6.7[E1]	6.7[E1]	4.6[E2]	5.4[E2]	F	F	F	4.2[E2]	F
70-74	23.3	39.1*	7.2[E1]	15.9*[E1]	6.7[E2]	10.9[E1]	5.4[E2]	3.5[E2]	5.1[E2]	F	4.6[E2]	F
75-79	30.9	48.3*	9.7[E1]	20.6*[E1]	7.2[E2]	17.4*	9.7[E2]	9.2[E1]	F	9.0*[E1]	F	5.1[E1]
80-84	45.5	62.6*	27.9[E1]	30.3[E1]	24.9[E1]	34.6	22.2[E1]	14.5[E1]	12.7[E2]	12.6[E1]	11.7[E2]	6.1[E2]
85+	49.2[E1]	77.5*	53.0	42.8	47.8[E1]	47.6	43.7[E1]	25.3[E1]	F	19.3[E1]	F	9.4[E2]

Data source: *1998/99 National Population Health Survey, cross-sectional sample, Health file*
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%
F Coefficient of variation greater than 33.3%
** Significantly different from value for men ($p \leq 0.05$)*

Table 1
Percentages and adjusted odds ratios for loss and recovery of independence between 1994/95 and 1996/97, by selected characteristics, household population aged 65 or older, Canada excluding territories

	Loss of independence			Recovery of independence		
	%	Adjusted odds ratio	95% confidence interval	%	Adjusted odds ratio	95% confidence interval
Total 65+	**13.9**	...	...	**32.1**	...	...
Sex						
Men	11.7	0.66*	0.45, 0.98	37.7E1	2.71*	1.25, 5.90
Women†	15.7	1.00	...	30.3	1.00	...
Age group						
65-69†	7.1E1	1.00	...	49.2	1.00	...
70-74	9.9	1.39	0.80, 2.41	40.1E1	0.65	0.24, 1.73
75-79	20.4*	3.13*	1.94, 5.05	35.1E1	0.52	0.20, 1.34
80-84	27.2*	4.60*	2.73, 7.75	24.7E2	0.19*	0.06, 0.58
85+	46.9*E1	13.89*	5.31,36.36	F	0.08*	0.02, 0.28
Living arrangements						
With spouse†	11.6	1.00	...	33.1	1.00	...
Alone	18.1*	0.99	0.68, 1.42	36.9	2.56*	1.20, 5.43
With others, no spouse	14.7E2	0.67	0.33, 1.34	F	1.30	0.48, 3.50
Chronic condition‡						
Asthma	15.0E2	0.96	0.38, 2.45	F	0.58	0.19, 1.75
Arthritis	16.7	1.15	0.80, 1.64	31.1	0.79	0.42, 1.48
Back problems (excluding arthritis)	15.5E1	1.32	0.83, 2.11	23.2E1	0.41*	0.21, 0.80
Bronchitis/Emphysema	25.0E1	2.68*	1.31, 5.48	26.8E2	0.54	0.14, 2.11
Diabetes	21.2E1	1.92*	1.08, 3.40	28.1E2	0.81	0.34, 1.94
Heart disease	24.4*	2.10*	1.26, 3.50	30.7E1	1.07	0.55, 2.08
Cancer	F	0.82	0.25, 2.69	42.4E2	1.50	0.42, 5.36
Effects of stroke	47.8*E1	5.68*	2.11,15.28	F	0.30*	0.12, 0.75
Urinary incontinence	F	1.49	0.61, 3.69	F	0.15*	0.04, 0.55
Glaucoma/Cataracts	18.4	0.93	0.57, 1.50	24.8E1	0.84	0.42, 1.70
Body mass index						
Underweight	35.2*E1	2.93*	1.22, 7.04	F	0.45	0.09, 2.25
Acceptable†	11.6	1.00	...	32.0	1.00	...
Overweight /Obese	14.4	1.52*	1.02, 2.26	34.5	1.09	0.57, 2.10
Missing§	F	1.39	0.33, 5.92	F	1.02	0.14, 7.45
Physical activity						
Active†	9.9	1.00	...	42.2	1.00	...
Inactive	23.2*	1.97*	1.32, 2.94	32.8	0.63	0.32, 1.23
Missing§	19.3E2	2.72*	1.21, 6.12	F	0.15*	0.03, 0.86
Smoking						
Smoker	15.9E1	1.70	0.99, 2.93	F	0.33*	0.12, 0.92
Non-smoker†	13.6	1.00	...	33.4	1.00	...
Alcohol consumption						
Regular drinker	F	0.58	0.15, 2.18	F	0.89	0.12, 6.35
Occasional/Non-drinker†	14.2	1.00	...	32.1	1.00	...
Education						
Less than postsecondary graduation†	15.1	1.00	...	30.5	1.00	...
Postsecondary graduation	8.2*	0.55*	0.32, 0.94	39.6E1	1.27	0.48, 3.40
Household income						
Low	21.6*	1.78*	1.19, 2.67	27.9E1	0.58	0.29, 1.18
Medium/High†	11.5	1.00	...	35.5	1.00	...
Missing§	15.3	1.48	0.67, 3.29	F	0.39	0.07, 2.13
Area of residence						
Urban†	14.0	1.00	...	30.0	1.00	...
Rural	13.6	0.96	0.64, 1.44	42.2E1	1.44	0.73, 2.86

Data source: *1994/95 and 1996/97 National Population Health Survey, longitudinal sample, Health file*
Notes: *The model for loss of independence is based on 1,921 respondents aged 65 or older who were independent and living in private households in 1994/95 and who were still alive in 1996/97; the model for recovery of independence is based on 399 respondents aged 65 or older who were dependent and living in private households in 1994/95 and still alive in 1996/97.*
† Reference category
‡ Reference category is no chronic condition.
§ Included in model to retain a large number of observations for which these variables were missing.
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%
F Coefficient of variation greater than 33.3%
** Significantly different from reference category ($p \leq 0.05$)*
... Not applicable

signficantly associated with transitions into and out of independent living, a multivariate analysis was conducted.

Age and sex "double-jeopardy" risk factors

Even when other factors—living arrangements, chronic conditions, weight, physical activity, smoking, drinking, education, household income, and area of residence—were taken into account, advancing age increased the odds of losing independence and reduced the odds of recovering it. In other words, age was a "double-jeopardy" risk factor. For example, individuals aged 85 or older in 1994/95 had 14 times the odds of experiencing a loss of independence by 1996/97, compared with 65- to 69-year-olds. And once people aged 85 or older became dependent, their odds of recovering were significantly lower than those of 65- to 69-year-olds.

Sex, too, was a "double-jeopardy" risk factor. Elderly men had lower odds than did elderly women of losing their independence. And if they experienced an episode of dependence, men had significantly higher odds of recovering. To some degree, this may reflect traditional gender roles related to the activities that define independence.

Living arrangements

When the other factors, including age and sex, were taken into consideration, living arrangements were significant only for the recovery of independence, specifically for seniors who lived alone. The odds that people who lived alone and were dependent in 1994/95 would recover their independence by 1996/97 were higher than the odds for people living with a spouse. A more detailed analysis (data not shown) found that the nature of the assistance that had been needed by dependent people who lived alone was generally less basic (for instance, shopping) than the assistance required by dependent people who lived with a spouse (for instance, personal care).

Chronic conditions major factor

Some chronic conditions posed more of a threat to independence than did others. Close to half (48%) of independent seniors who were affected by stroke had become dependent by 1996/97. And in fact, when the effects of the other variables were controlled, stroke was the only chronic condition that was a "double-jeopardy" risk factor, associated with high odds of losing independence and low odds of recovering it. This is hardly surprising, since the consequences of a stroke can be especially disabling: partial or total paralysis, sensory or muscle tone loss, nerve damage, speech difficulties, confusion, and memory loss.

Seniors with bronchitis/emphysema, diabetes or heart disease had high odds of becoming dependent. However, having these conditions did not significantly reduce the odds of recovering independence. By contrast, individuals with back problems and urinary incontinence did not have high odds of losing their independence, but they had significantly low odds of recovering once they had become dependent.

Several conditions were not significantly associated with losing or recovering independence at older ages: asthma, arthritis, and cancer. For asthma and arthritis, this might seem surprising, although the relatively short period examined (two years) may not be long enough to observe a substantial deterioration in functional health related to these diseases. It is noteworthy that cancer, a major risk factor for loss of life, was not significantly related to loss of independence. This may be because people who died of cancer between 1994/95 and 1996/97 were, by definition, excluded from the analysis, although they would have been the cancer patients most at risk of losing their independence.

Co-morbidity (having more than one chronic condition) was tested, but was not significant for the loss or recovery of independence (data not shown). This suggests that it is not so much the number, but rather the type, of chronic conditions that imperils independent living.

To assess the importance of chronic diseases, as well as behavioural and socio-economic factors, on the loss and recovery of independence, three models were produced (data not shown). One at a time, each group of variables was removed. Chronic

conditions proved to have the strongest association with both the loss and recovery of independence. But behavioural factors were also significant in the loss of independence, illustrating that habits and lifestyle developed during youth and adulthood can have an impact on functional health in old age.

Health-related behaviours

Just 12% of seniors whose weight was in the acceptable range in 1994/95 had become dependent by 1996/97. However, 35% of underweight seniors lost their independence. When the effects of other variables (some closely related to BMI such as physical activity and smoking) were taken into account, both too much and too little weight were significantly related to seniors' loss of independence. The odds that elderly people who were independent in 1994/95 would be dependent in 1996/97 were significantly high for those who were overweight/obese or underweight, compared with those in the acceptable weight range. Being underweight may be a marker of frailty related to an unreported or undiagnosed disease, which may, in turn, explain the significant association.

Limitations

Some people selected for the National Population Health Survey (NPHS) longitudinal panel in 1994/95 did not respond in 1996/97. Some were lost to follow-up; others no longer wanted to participate. Because loss to follow-up represented less than 2% of all respondents in the longitudinal panel (a proportion considered very low),[46] and because most of these missing respondents were young, it was not an important source of bias in this analysis. Non-response is a greater concern, and adjustments to survey weights were applied to responses in both cycles to compensate.[4,47] Nonetheless, it is possible that some bias remains.

Every effort was made to collect in-depth health information directly from the randomly selected individuals. However, proxy responses were accepted and accounted for 21.4% of household records in this analysis. This might lead to under-reporting of some characteristics and dilute associations between the loss or recovery of independence and specific variables. For instance, a person reporting on behalf of another may not be fully aware of that person's health situation, may not recall relevant health information, or may mislabel health problems.[48,49] However, an analysis of proxy reporting in the NPHS showed that for more serious conditions such as diabetes, heart disease and stroke, the odds that they will be reported do not differ significantly between proxy and self-reporters.[50]

The relatively few respondents aged 65 or older in the longitudinal file limited opportunities for analysis. Selection of variables for inclusion in the model meant balancing the desirability of accounting for as many factors in the conceptual framework as possible against limits imposed by the data. For example, the conceptual framework originally included social support and mental health. When the models were run including those variables, neither was significant. Similarly, loss of independence among the elderly can often result from a fall leading to hip fractures or other injuries, especially at very advanced ages. About 7% of independent seniors in 1994/95 were victims of injuries leading to activity limitations, and approximately 2% suffered fractures. This variable, too, was initially included in the multivariate models, but the associations were not significant, possibly because of the small number of cases.

The relatively small sample size also meant that transitions between only two functional health states could be investigated: independent and dependent in activities of daily living. Furthermore, the "dependent" population is heterogeneous. The range of activities for which they required assistance ranged from shopping only to personal care such as dressing and bathing. Although a breakdown of the dependent population into more homogeneous categories would have been desirable, it was not possible.

A small sample size also meant that the coefficients of variation associated with some variable categories were large, and consequently, estimates could not be shown.

Respondents may give socially desirable answers to questions about issues such as smoking, alcohol consumption and weight. As well, several studies have shown that body mass index (BMI) based on self-reported height and weight can be unreliable,[34,35,51] particularly among the elderly. Advancing age leads to a decline in body mass owing to the loss of muscle and bone mass.[30,52,53] Inaccurate self-reporting of height is also common among the elderly, who frequently experience loss of height as they age.[54,55]

The NPHS does not provide an indication of the severity of chronic conditions. Thus, while the results of this analysis show that dependence was not significantly related to having been diagnosed with, for example, arthritis, in severe cases, there might be some association.

Physical activity was also important. Compared with elderly people who were active, a higher percentage of those who were inactive lost their independence. When the effects of the other factors were controlled, inactivity increased the odds of a loss of independence, but was not associated with its recovery. However, the "missing-value" category for physical activity was significantly related to both the loss and recovery of independence. This may be explained by the age/sex profile of these non-respondents, a large majority of whom were aged 80 or older and reported poor health.

Even when the other variables were taken into consideration, daily or occasional smokers who were dependent had reduced odds of recovering, compared with individuals who did not smoke. Alcohol consumption, by contrast, was not significantly related to either loss or recovery of independence among the elderly.

Education, income and residence

Comparatively high percentages of elderly people in low-income households or with less than high school graduation became dependent between 1994/95 and 1996/97. When other variables were taken into account, the odds of becoming dependent were still high for elderly people who were not postsecondary graduates, compared with individuals who had more formal education. Low household income, too, was associated with becoming dependent. Neither education nor income was significantly related to the recovery of independence. A more detailed breakdown of the education and income categories (data not shown) indicated that education's positive effect existed only for the most highly educated seniors, and that the negative effect of low income prevailed only at very low income levels.

The high odds of a loss of independence among low-income seniors may partly reflect a perceptual difference between individuals with adequate means and those with inadequate means.[56] Seniors who can afford to pay for help with the tasks on which the definition of independence is based, and who have long had such help, may not regard this as being dependent. They might also be unaware that they would be unable to perform these activities if they lacked the resources to pay for the service.

It might be hypothesized that health care and support services designed to foster independence would be less accessible in rural than in urban settings. However, the odds that seniors living in rural areas would lose or recover their independence did not differ significantly from the odds for urban residents.

Concluding remarks

According to longitudinal data from the National Population Health Survey, transitions between states of functional health are not invariably one-way for elderly people: a substantial number regain their independence after an episode of dependence. Thus, functional health is a dynamic process and is not uni-directional. The loss or recovery of independence is associated with a variety of demographic, health, lifestyle, and socio-economic characteristics.

Although age was not the only factor related to transitions between independence and dependence among seniors between 1994/95 and 1996/97, it was very important, ranking among a small number of "double-jeopardy" risk factors. That is, all else being equal, aging was associated with high odds of losing independence and low odds of regaining it.

Sex, too, was a "double-jeopardy" risk factor. Elderly women had higher odds than did elderly men of losing their independence and lower odds of recovering it after an episode of dependency. These results point to a paradox: men are at greater risk of dying at all ages, but at less risk of becoming dependent. This association may be related to gender roles, since independence is measured largely in terms of the ability to perform domestic tasks. Housework and shopping for necessities more often fall to women,[57] so men may be less exposed to the risk of losing independence defined in this way.

Stroke was the only chronic condition among those examined that presented a "double risk" to independent living. But to properly assess its impact, the prevalence of stroke should also be considered. Stroke affected relatively few seniors in 1994/95: less than 2% who were independent and 11% who

were dependent (Appendix Table A). By contrast, heart disease and diabetes, both of which were significantly related to the loss of independence, were reported by 13% and 9%, respectively, of independent seniors, and by 30% and 16% of those who were dependent. And back problems, which were associated with low odds of recovering independence, were reported by 35% of dependent seniors. Consequently, from a population-health perspective, the impact of heart disease, diabetes and back problems on seniors' independence can be greater than that of stroke.

Given the role of chronic conditions in the loss and recovery of independence, recent trends in some of these conditions provide clues about dependency among tomorrow's elderly. Cohorts born before 1950 are more likely than younger cohorts to have cardiovascular disease, arthritis and emphysema.[58] Heart disease has been found to be more prevalent among older cohorts, but diabetes is more common among those born after 1947.[40] These findings demonstrate the importance of longitudinal analysis, which makes it possible to treat population aging as a process in which successive cohorts reshape the profile of the elderly population.

Smoking had a significant association with dependence: smokers had lower odds of recovering their independence once they had lost it, compared with non-smokers. This finding, consistent with other studies,[41,42] indicates that smoking cessation may not only save lives, but also reduces the burden of dependency in old age.

Two other behavioural factors—physical activity and weight (BMI)—were significantly associated with a loss of independence, suggesting some scope for developing health policies and programs designed to encourage healthy lifestyles.

Low education and low income were both associated with loss of independence. The steady increase in educational attainment among successive cohorts, and the concomitant rise in household income, especially among women,[40] might have a favourable impact on independence among the elderly in the future.

A more complete understanding of the dynamics of functional health and of the factors associated with it should enable policy-makers to better grasp the range of choices available to them. Programs designed to encourage healthy lifestyles and prevent disabling diseases such as stroke, diabetes and heart disease might be conducive to successful aging. ●

References

1 Statistics Canada. *Population projections for Canada, provinces and territories, 2000-2026* (Catalogue 91-520-XBP) Ottawa: Minister of Industry, 2001.

2 Contandriopoulos M-A. Quel avenir pour le système de soins canadien? *Isuma* 2000; 1(1): 39-43.

3 Health Canada. Federal, Provincial and Territorial Advisory Committee on Population Health. *Toward a Healthy Future. Second Report on the Health of Canadians*. Ottawa: Minister of Public Works and Government Services, 1999.

4 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.

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

6 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.

7 Rust KF, Rao JNK. Variance estimation for complex surveys using replication techniques. *Statistical Methods in Medical Research* 1996; 5: 281-310.

8 Yeo D, Mantel H, Liu TP. Bootstrap variance estimation for the National Population Health Survey. *American Statistical Association: Proceedings of the Survey Research Methods Section*. Baltimore: August 1999.

9 Manton KG. A longitudinal study of functional change and mortality in the U.S. *Journal of Gerontology* 1988; 43: 5153-61.

10 Branch LG, Ku L. Transition probabilities to dependency, instutionalization and death among the elderly over a decade. *Journal of Ageing and Health* 1989; 1: 370-408.

11 Rogers RG, Rogers A, Bélanger A. Active life among elderly in the United-States: Multistate life table estimates and population projections. *The Milbank Quarterly* 1989; 67 (3-4): 370-411.

12 Rogers RG, Rogers A, Bélanger A. Disability-free life among the elderly in the United States. *Journal of Ageing and Health* 1992; 4(1): 19-42.

13 Manton KG, Corder LS, Stallard E. Estimates of change in chronic disability and institutional incidence and prevalence rates in the U.S. elderly population from the 1982, 1984 and 1989 National Long Term Care Survey. *Journal of Gerontology* 1993; 48(4): S153-66.

14 Crimmins EM, Saito Y. Getting better and getting worse. Transitions in functional status among older Americans. *Journal of Ageing and Health* 1993; 5: 3-36.

15 Mor V, Wilcox V, Rakowski W, et al. Functional transitions among the elderly: Patterns, predictors, and related hospital use. *American Journal of Public Health*, 1994; 84(4): 1274-80.

16 Runberg MA, Parzen MI, Leonard LA, et al. Functional limitation pathways and transitions in community-dwelling older persons. *Gerontologist* 1996; 36(4): 430-40.

17 Béland F, Zunzunegui MV. Predictors of functional status in older people living at home. *Age and Ageing* 1999; 28: 153-9.

18 Allaire SH, LaValley MP, Evans SR, et al. Evidence for decline in disability and improved health among persons aged 55 to 70 years : The Framingham Heart Study. *American Journal of Public Health* 1999; 89(11): 1678-83.

19 Chen J, Millar WJ. Health effects of physical activity. *Health Reports* (Statistics Canada, Catalogue 82-003) 1999; 11(1): 21-30.

20 Shields M, Chen J. Health among older adults. *Health Reports* (Statistics Canada, Catalogue 82-003) 2000; 11(3): 47-61.

21 Wolf DA, Freedman V, Marcotte J, et al. Periodicity and occurrence bias in estimates of disablement transitions. Presented at REVES 12. Los Angeles: March 20-22, 2000.

22 Wolf DA, Laditka SB. Stochastic modeling of active life and its expectancy. Presented at REVES 9. Rome: December 11-13, 1997.

23 Andersen RM, McCutcheon LA, Aday LA, et al. Exploring dimensions of access to medical care. *Health Services Research* 1983; 18(1): 49-74.

24 Evans RG, Stoddart GL. *Producing Health, Consuming Health Care.* CHEPA Working Paper No. 90-6. Hamilton, Ontario: McMaster University, 1990.

25 Verbrugge L, Jetté AM. The disablement process. *Social Science and Medicine* 1994; 38(1): 1-14.

26 Jagger C, Spiers NA, Clarke M. Factors associated with decline in function, institutionalization and mortality of elderly people. *Age and Ageing* 1993; 22: 190-7.

27 Kaplan GA, Strawbridge WJ, Camacho T, et al. Factors associated with change in physical functioning in the elderly: a six-year prospective study. *Journal of Ageing and Health* 1993; 5: 140-53.

28 Grundy E, Glaser K. Trends in, and transitions to, institutional residence among older people in England and Wales, 1971-91, *Journal of Epidemiology and Community Health* 1997; 51: 531-40.

29 Trottier H, Martel L, Houle C, et al. Living at home or in an institution: What makes the difference for seniors? *Health Reports* (Statistics Canada, Catalogue 82-003) 2000; 11(4): 49-61.

30 Gilmore J. Body mass index and health. *Health Reports* (Statistics Canada, Catalogue 82-003) 1999; 11(1): 31-43.

31 World Health Organisation. *Obesity: Preventing and Managing the Global Epidemic.* Geneva: World Health Organisation, 1997.

32 Golini A, Amendola G, Falorni C. Height, body mass index and self-perceived health. The case of the Italian population. Presented at REVES 12. Los Angeles: March 20-22, 2000.

33 Himes CL. Obesity, disease, and functional limitation in later life. *Demography* 2000; 37(1): 73-82.

34 Folsom AR, Kaye SA, Sellers TA, et al. Body fat distribution and 5-year risk of death in older women. *Journal of the American Medical Association* 1993; 269: 483-7.

35 Manson JE, Willett WC, Stampfer MJ, et al. Body weight and mortality among women. *New England Journal of Medicine* 1995; 333: 677-85.

36 Lawton MP, Brody EM. Assessment of older people: Self-maintaining and instrumental activities of daily living. *Gerontologist* 1969; 9(3): 179-86.

37 Katz S, Ford AB, Moskowitz RW. Studies of illness in the aged. The Index of ADL, a standardized measure of biological and psychological function. *Journal of the American Medical Association* 1963; 185(12): 914-9.

38 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.

39 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.

40 Chen J, Millar WJ. Are recent cohorts healthier than their predecessors? *Health Reports* (Statistics Canada, Catalogue 82-003) 2000; 11(4): 9-23.

41 Nusselder WJ, Looman CW, De Mheen PJ, et al. Smoking and the compression of morbidity. *Journal of Epidemiology and Community Health* 2000; 54(8): 566-74.

42 Martel L, Bélanger A, Berthelot J-M. Smoking and disability-free life expectancy in Canada. *Report on the Demographic Situation in Canada* (Statistics Canada, Catalogue 91-209) Ottawa: Minister of Industry, 2001.

43 Spies CD, Sander M, Stangl K, et al. Effects of alcohol on the heart. *Current Opinion in Critical Care* 2001; 7(5): 337-43.

44 Murray RP, Connett JE, Tyas SL, et al. Alcohol volume, drinking pattern, and cardiovascular disease morbidity and mortality: Is there a U-shaped function? *American Journal of Epidemiology* 2002; 155(3): 242-8.

45 Millar WJ, Stephens T. Social status and health risks in Canadian adults: 1985 and 1991. *Health Reports* (Statistics Canada, Catalogue 82-003) 1992; 5(2): 143-56.

46 Béland Y, Bustros J. *Aperçu global de la qualité de l'enquête nationale sur la santé de la population.* Assemblée annuelle de la SSC, Recueil de la Section des méthodes d'enquêtes, 1998.

47 Tambay J-L, Schiopu-Kratina I, Mayda J, et al. Treatment of nonresponse in cycle two of the National Population Health Survey. *Survey Methodology* (Statistics Canada, Catalogue 12-001) 1998; 24(2): 147-56.

48 Miller RE, Massagli MP, Clarridge BR. Quality of proxy vs. self reports: evidence from a health survey with repeated measures. *American Statistical Association: Proceedings of the Section on Survey Research Methods.* Washington, DC: American Statistical Association, 1986: 546-51.

49 National Center for Health Statistics. Reporting of hospitalization in the Health Interview Survey. *Vital and Health Statistics* 1973; 2(54): 1-24.

50 Shields M. Proxy reporting in the National Population Health Survey. *Health Reports* (Statistics Canada, Catalogue 82-003) 2000; 12(1): 21-39.

51 Losonczy KG, Harris TB, Coroni-Huntley EM, et al. Does weight loss from middle age to old age explain the inverse weight mortality relation in old age? *American Journal of Epidemiology* 1995; 141: 312-21.

52 Baumgartner RN, Heymsfield SB, Roche AF. Human body composition and the epidemiology of chronic disease. *Obesity Research* 1995; 3: 73-95.

53 Hayflick L. *How and Why We Age*. New York: Ballantine, 1996.

54 Kuskowska-Wolk A, Karlsson P, Stolt M, et al. The predictive validity of body mass index on self-reported weight and height. *International Journal of Obesity* 1989; 13(4): 441-53.

55 Rowland ML. Self-reported weight and height. *American Journal of Clinical Nutrition* 1990; 52(6): 1125-33.

56 Wilkins K, Park E. Chronic conditions, physical limitations and dependency among seniors living in the community. *Health Reports* (Statistics Canada, Catalogue 82-003) 1996; 8(3): 7-15.

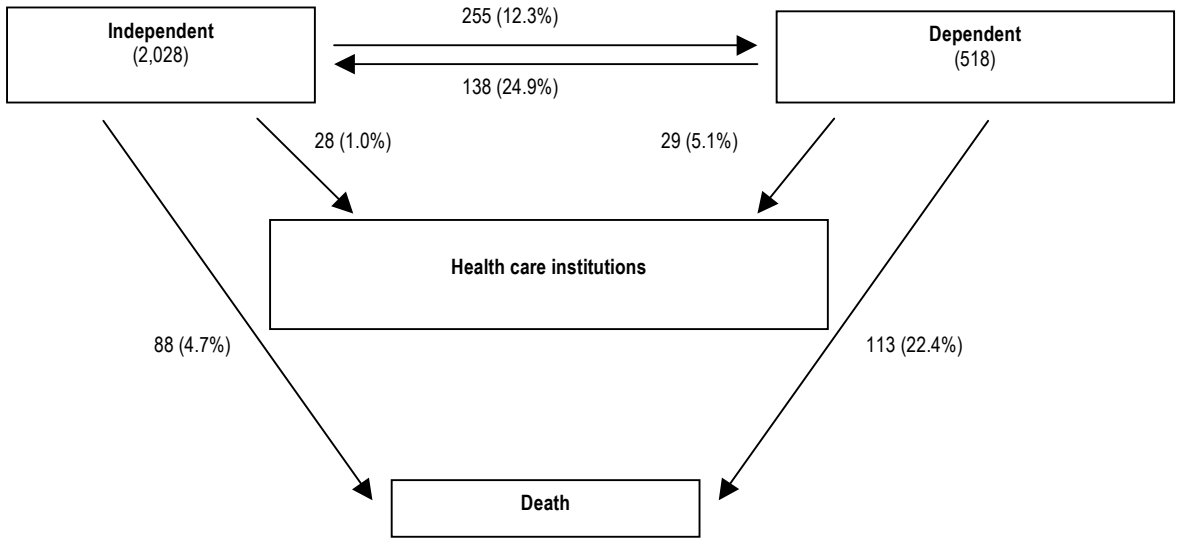
57 Marshall K. Employed parents and the division of housework. *Perspectives on Labour and Income* (Statistics Canada, Catalogue 75-001E) 1993; 5(3): 23-30.

58 Reynolds SL, Crimmins EM, Saito Y. Cohort differences in disability and disease presence. *Gerontologist* 1998; 38(5): 578-90.

Appendix

Chart A

Dynamics of dependency over two years, household population aged 65 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*
Note: *Percentages in parentheses based on weighted data*

Table A
Selected characteristics of independent and dependent household population aged 65 or older, Canada excluding territories, 1994/95

	Independent		Dependent	
		Sample size		Sample size
Average age (years)	72.4	1,921†	77.5	399‡
	%		%	
Sex				
Men	45.2	796	25.5	89
Women	54.8	1,125	74.5	310
Age				
65-69	37.9	652	17.5	67
70-74	30.7	583	21.0	86
75-79	18.7	385	24.0	92
80-84	8.3	214	19.4	86
85+	4.5	87	18.2[E1]	68
Living arrangements				
With spouse	59.0	893	39.9	129
Alone	29.5	880	43.0	238
With others, no spouse	11.5	148	17.1[E1]	32
Chronic condition				
Asthma	4.5	86	6.9[E1]	32
Arthritis	36.0	739	66.0	274
Back problems (excluding arthritis)	15.3	289	35.2	126
Bronchitis/Emphysema	5.0	100	12.7[E1]	50
Diabetes	9.2	160	16.0[E1]	60
Heart disease	13.1	264	29.5	114
Cancer	4.2	78	6.7[E1]	26
Effects of stroke	1.9[E1]	36	11.1[E1]	42
Urinary incontinence	2.4[E1]	45	9.9[E1]	39
Glaucoma/Cataracts	13.3	294	28.0	102

	Independent		Dependent	
		Sample size		Sample size
	%		%	
Body mass index				
Underweight	3.2	56	4.3[E2]	23
Acceptable	44.5	843	49.0	191
Overweight/Obese	51.3	1,011	45.2	181
Missing	F	11	F	4
Physical activity				
Active	68.4	1,275	28.4	119
Inactive	26.3	574	57.6	254
Missing	5.3	72	14.0[E1]	26
Smoking				
Smoker	13.9	265	15.7[E1]	58
Non-smoker	86.1	1,656	84.3	341
Alcohol consumption				
Regular drinker	4.1	79	F	8
Occasional/Non-drinker	95.9	1,842	97.6	391
Education				
Less than postsecondary graduation	82.3	1,603	82.0	333
Postsecondary graduation	17.7	318	18.0	66
Household income				
Low	21.8	576	36.0	181
Medium/High	72.8	1,249	60.3	202
Missing	5.4	96	3.7[E2]	16
Area of residence				
Urban	82.8	1,399	82.1	283
Rural	17.2	522	17.9	116

Data source: *1994/95 National Population Health Survey, longitudinal sample, Health file*
Note: *Percentages calculated using weighted data*
† Figure obtained by subtracting 88 deaths and 17 cases for which values were missing from the 2,028 independent seniors observed in 1994/95.
‡ Figure obtained by subtracting 113 deaths and 5 cases for which values were missing from the 518 dependent seniors observed in 1994/95.
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%
F Coefficient of variation greater than 33.3%

Disability-free life expectancy by health region

Francine Mayer, Nancy Ross, Jean-Marie Berthelot and Russell Wilkins

Abstract

Objectives

This article presents a profile of variations in disability-free life expectancy (DFLE) by health region.

Data sources

Mortality data for 1995 through 1997 are from the Canadian Vital Statistics Database. Estimates of disability (major activity limitations) and socio-demographic characteristics are based on data from the 1996 Census. Supplementary information was provided by the Demography and Geography divisions at Statistics Canada.

Analytical techniques

DFLE was calculated using a modified version of Sullivan's method. Linear regression using 4 factors representing socio-demographic profiles was used to explain the variation of DFLE by health region. These 4 synthetic variables were determined using principal component analysis.

Main results

In 1996, DFLE for both sexes was estimated to be 68.6 years. Estimates by health region varied considerably. Socio-economic status explains a high proportion of the variation of DFLE by health region.

Key words

health expectancy, activity limitations, Sullivan's method, geographic comparisons

Authors

Francine Mayer (514-987-3000, ext. 8382; mayer.francine@uqam.ca) is with the Département des sciences économiques at l'Université du Québec à Montréal, Montréal, Québec, H3C 3P8. Nancy Ross (514-398-4307; nancy.ross@mcgill.ca) is with the Department of Geography at McGill University in Montréal, Québec, H3A 2K6, and the Health Analysis and Measurement Group at Statistics Canada. Jean-Marie Berthelot (613-951-3760; jean-marie.berthelot@statcan.ca) and Russell Wilkins (613-951-5305; russell.wilkins@ statcan.ca) are with the Health Analysis and Measurement Group at Statistics Canada, Ottawa, Ontario, K1A 0T6.

Life expectancy is a frequently used indicator of the health of a population. However, because it is based exclusively on mortality and population data, life expectancy measures length of life without considering health-related quality of life. As life expectancy increased throughout the 20th century, chronic illnesses and functional limitations became more common. Thus, although it remains useful, life expectancy is not an entirely satisfactory indicator of overall population health.

Public health officials have long recognized that a more useful measure would expand the concept of life expectancy to include an individual's ability to function in society.[1,2] Disability-free life expectancy (DFLE) is one such measure. It can be used to distinguish between years free of any disability and years lived with at least one disability. DFLE represents an important conceptual expansion of the conventional life expectancy indicator.

This article presents a profile of variations in disability-free life expectancy in Canada's health regions (see *Methods* and *Limitations)*. For this analysis, disability is defined as

Methods

Data sources

Mortality data for 1995 to 1997 are from the Canadian Vital Statistics Database. Population estimates as of July 1, 1996, adjusted for net census undercoverage, are from Statistics Canada's Demography Division. The numbers of people living in private households and collective dwellings are from the 1996 Census of Population. Estimated data for major activity limitation and the demographic and socio-economic variables for multivariate analysis are from the 20% sample for the 1996 Census long form. Because this sample excludes people living in collective dwellings, the rates of major activity limitations for such individuals were based on two assumptions: (1) that all people living in health care institutions had at least one major activity limitation; and (2) that residents of other collective dwellings (for example, rooming houses, military camps, prisons and missions) had major activity limitation rates, by sex and age group, identical to those of people living in private households.

Estimates of population density and the number of frost-free days were provided by Statistics Canada's Geography Division.

Analytical techniques

The estimates of disability-free life expectancy were calculated using a modified version of Sullivan's prevalence-based method (1971).[3] Abridged life tables by five-year age groups were calculated using Chiang's method (1984),[4] except for the open age interval (not covered by Chiang), for which the person-years of life lived (LL) were calculated as the product of the number of survivors at the beginning of the age interval (L) times the average remaining life expectancy at that age (LE), which was taken as the inverse of the death rate. Chiang's method includes a formula for calculating the variance in life expectancy estimates that takes into account stochastic fluctuations in the death rates observed.

Sullivan's method is based on point-prevalence rates of disability in a population at a given time, by sex and age group. In the health expectancy table, the number of years lived is calculated separately for each health status in order to calculate life expectancy in health care institutions and life expectancy outside such institutions but with major activity limitations.

The number of years lived in health care institutions and the number of years lived outside such institutions with major activity limitations, for males and females and for each age group, were obtained as follows:[5,6] The number of years lived regardless of health status (LL) was multiplied by the prevalence rates for major activity limitations; that is, the proportion of people in health care institutions (inst) and the proportion of people outside health care institutions who reported limitations in their major activities (lim). As previously mentioned, it was assumed that people living in collective dwellings other than health care institutions had the same major activity limitation rates, by sex and age group, as individuals in private households. Thus: LLinst = LL x inst and LLlim = (LL - LLinst) x lim. Then, the accumulated total of years lived for each health status (TLL, TLLinst and TLLlim) from the highest to the lowest age group was divided by the number of survivors at each age (L) to give the life expectancy at each age and for each health status: conventional life expectancy (LE = TLL ÷ L), life expectancy in health care institutions (LEinst = TLLinst ÷ L) and life expectancy outside health care institutions but with major activity limitations (LElim = TLLlim ÷ L).

Separate calculations were done for men and women. Then, L, LL, LLinst, LLlim, TLL, TLLinst and TLLlim for both sexes combined were calculated using the average of the corresponding values by sex, so that the actual distribution by sex and by age in the health regions has no effect on the results in the health expectancy table.

Disability-free life expectancy (DFLE) was obtained by subtracting the sum of life expectancy in health care institutions and life expectancy outside health care institutions but with major activity limitations from life expectancy: DFLE = LE - (LEinst + LElim).

The variances relating to the estimates of DFLE were obtained using the formula proposed by Mathers (1991).[7] This method takes into consideration both the stochastic fluctuations in the death rates observed and the sampling variability of the disability rates. The lower and upper limits of the confidence intervals of those estimates were calculated on the assumption that the sampling distribution of DFLE is normal.

The estimates of DFLE in the health regions are presented by quartile (Map). The health regions of the first quartile comprise the 25% of regions where DFLE was lowest, whilethose in the fourth quartile make up the 25% of both regions where DFLE was highest. The health regions in the second and third quartiles were in intermediate positions.

A three-step approach was used to identify possible explanations behind differences in DFLE. First, 21 variables, largely demographic and socio-economic, were selected as factors potentially associated with the variations in DFLE in the 138 health regions. Through principal component analysis (a method to reduce the number of variables), the 21 original variables, some of which were strongly collinear, were grouped into 4 synthetic orthogonal variables by construction (principal components), thereby eliminating the problems associated with multicollinearity (Appendix Table A). These 4 synthetic variables—"remote," "prosperous," "cosmopolitan" and "disadvantaged"—are linear combinations of the 21 original variables and account for 73% of their total variance.

The "remote" component contains variables such as a high male/female ratio, a large proportion of Aboriginal residents and low educational attainment. The "prosperous" component is marked by high population growth, high personal incomes and low unemployment; "cosmopolitan," by high proportions of visible minority groups, high population densities and high proportions of recent immigrants. The "disadvantaged" component indicates high proportions of lone-parent families and low proportions of owner-occupied housing. Calculations were done using the SAS PROC factor. The third stage estimates a linear regression model of disability-free life expectancy, with the 4 synthetic variables as explanatory variables.

having a major activity limitation; that is, a limitation that affects activities at home, at work, or at school (see *Definitions*). The association between DFLE and selected socio-economic and demographic characteristics at the health region level is examined. Only two previous studies have examined explanatory factors for disability-free life expectancy at the regional level.[8,9] The findings in this analysis are based on estimates of DFLE for 1996 (Appendix Table B).

DFLE inequalities considerable

Disability-free life expectancy (DFLE) for both sexes in Canada was estimated at 68.6 years in 1996 (Table 1, Chart). This figure masks the considerable variations in DFLE by health region: from 61 years in the Nunavik region of Québec to close to 73 years in the Richmond, British Columbia region—a gap of close to 12 years. A discrepancy of this magnitude suggests that improvements in health are possible in the health regions where estimates of DFLE are lowest.

Certain characteristics of the Nunavik and Richmond regions may partly explain the discrepancy between the two. Nunavik is an immense, sparsely populated territory situated in northern Québec. In 1996, Nunavik's population of less than 9,000 was mostly Aboriginal (88%). Mortality and morbidity rates are higher in the Aboriginal population than in the general Canadian population.[10] This is reflected in the lower DFLE scores of regions with large Aboriginal populations.

Only 35% of Nunavik's population aged 25 to 54 had a postsecondary degree, certificate or diploma, reflecting the relatively lower levels of education in this region. Moreover, 25% of Nunavik families were headed by lone parents, and less than 1% of the population were immigrants. Nunavik is also far from major urban centres, making access to health care services somewhat problematic for its residents.

By contrast, Richmond is located in the greater Vancouver area, an industrial, port, university and tourist region, where health care services are widely available. Richmond's population—over 1.5 million in 1996—is also highly educated. In 1996, 58% of inhabitants aged 25 to 54 were postsecondary graduates. In addition, close to half (48%) of Richmond's population were immigrants, many of whom (67%) arrived in Canada after 1980. And less than 1% of the population were of Aboriginal origin in 1996.

Table 1
Life expectancy and disability-free life expectancy, both sexes, Canada, 1996

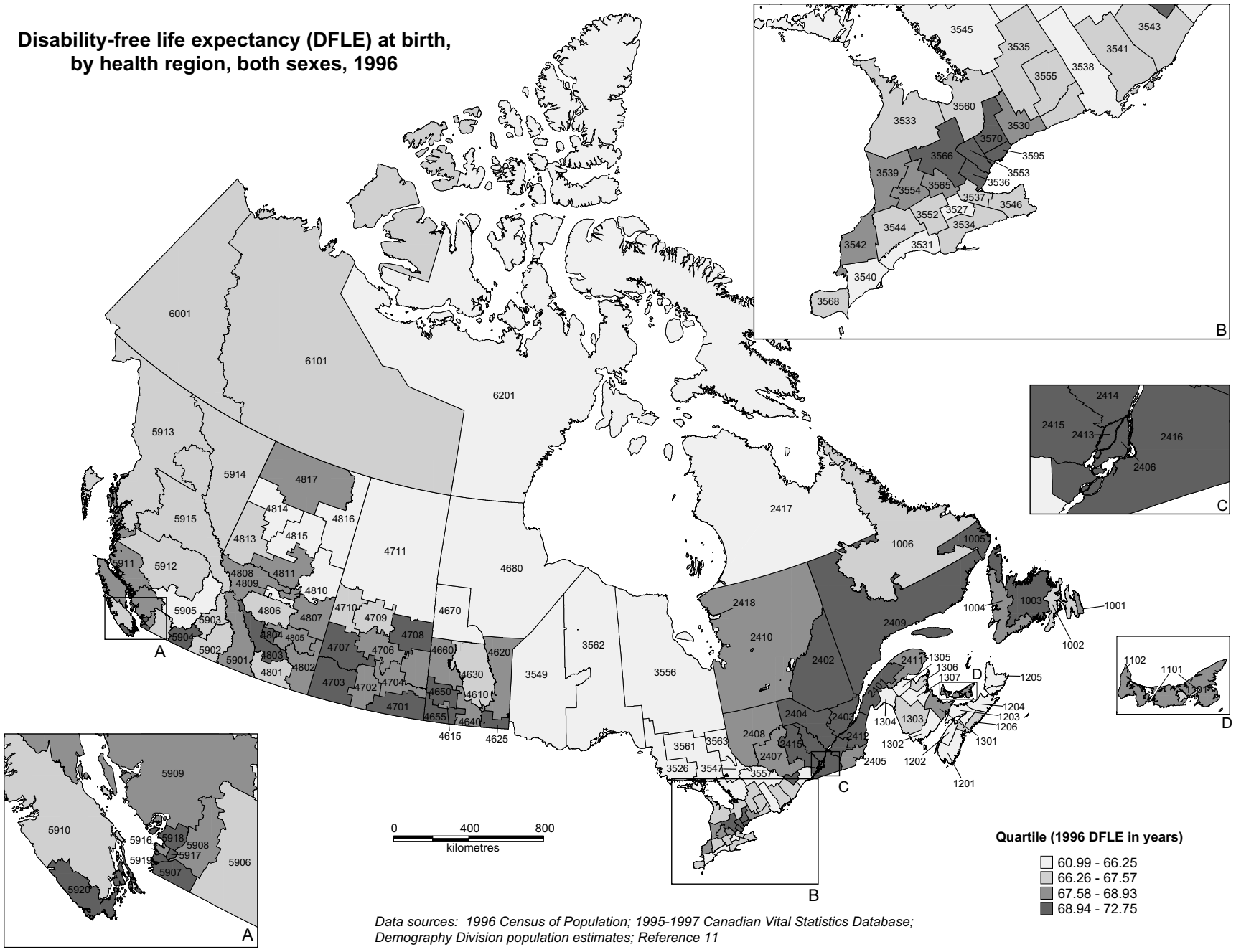
	Life expectancy		Disability-free life expectancy	
	Years	95% confidence interval	Years	95% confidence interval
Canada	**78.3**	**78.3, 78.4**	**68.6**	**68.5, 68.6**
Minimum†	65.4	63.0, 67.7	61.0	58.8, 63.2
Maximum‡	81.2	80.8, 81.7	72.8	72.3, 73.2
Range§	15.8	13.1, 18.7	11.8	9.1, 14.4

Data sources: *1996 Census of Population; 1995-1997 Canadian Vital Statistics Database; Demography Division population estimates; Reference 11*
† Minimum value observed for a health region
‡ Maximum value observed for a health region
§ Difference between maximum and minimum values

DFLE higher in urban areas, lower in more remote areas

In 1996, the health regions in the lowest DFLE quartile were generally in northern or rural regions far from major urban centres (Map). In this 25% of health regions, DFLE ranged from 61.0 to 66.3 years. Conversely, the health regions in the top 25%, or the highest quartile, were generally in or adjacent to and highly integrated with urban areas. There, DFLE ranged from 68.9 to 72.8 years. Many of these regions are in southern Ontario and the West, where economies are among the most robust in the country. Few health regions in the highest quartile were in the Atlantic region, where economies are relatively fragile. With the exception of Québec, this regional pattern of DFLE is similar to that pertaining to life expectancy.[12]

In Québec, 11 of 18 health regions were in the highest DFLE quartile, with 15 of the 18 above the median. Rates of major activity limitation are much lower in Québec, compared with the other provinces. This lower disability rate has consistently been observed in the past and with different survey instruments.[5]



Data sources: 1996 Census of Population; 1995-1997 Canadian Vital Statistics Database; Demography Division population estimates; Reference 11

Definitions

Life expectancy is the number of years a person would be expected to live, starting from birth, based on the mortality rates for a given period (1995 to 1997), established by five-year age groups.

Disability-free life expectancy (DFLE) differentiates between years of life free of any major activity limitations or residence in a health care institution (where many residents have major activity limitations) and years lived with at least one major activity limitation (see *Methods*). This concept establishes a threshold based on the nature of such limitations. Years of life lived in conditions equal to or above that threshold are counted in full, while those lived in lesser conditions are not counted.

Major activity limitations are those caused by a long-term physical or mental condition or a long-term health problem; that is, one that has lasted, or is expected to last, six months or more. Minor activity limitations or non-disabling impairments are excluded. A positive response to either of the following census questions was considered to indicate a major activity limitation: "Is this person limited in the kind or amount of activity that he/she can do because of a long-term physical condition, mental condition or health problem: at home? at school? or at work?"

In general, *health regions* correspond to the administrative areas established by provincial authorities for local health and social services delivery. Although there are actually 139 health regions (Map, Appendix Table A), for this analysis, the Burntwood and Churchill health regions in Manitoba were combined because of their small populations. Health regions are extremely diverse, particularly in terms of population size, demographic and socio-economic characteristics, and level of urbanization.

Male/Female ratio is the total number of males in a given health region in 1996 divided by the total number of females.

Population < 15 is the proportion of a health region's population younger than 15.

Aboriginal represents the proportion of the health region's total population who identified themselves as belonging to an Aboriginal group: First Nations, Inuit or Métis on the 1996 Census.

Strong metropolitan influenced zone (MIZ) refers to the proportion of the population living in census metropolitan areas (CMAs), census agglomerations (CAs) and communities that fall outside CMAs/CAs in which at least 30% of the employed labour force commutes to the CMAs/CAs. The measure is used to describe the degree of urban influence in the health region. CMAs and CAs are large urban areas, together with adjacent urban and rural areas that have a high degree of economic and social integration with that urban area. CMAs and CAs have attained certain population thresholds: 100,000 for CMAs and 10,000 for CAs.

Frost-free days represent the average annual number of days with a temperature above 5 degrees Celsius.

Housing inaffordability indicates the proportion of households spending more than 30% of their income on shelter.

Education 25-54 is the proportion of a health region's population aged 25 to 54 with a postsecondary degree, certificate or diploma.

Population ≥ 65 is the proportion of the health region's population aged 65 or older.

Internal migration is the proportion of the health region's population aged 5 or older that lived in a different census subdivision (municipality) at the time of the previous census (1991). Canadians living in households outside Canada, such as military and government personnel, are excluded.

Population change represents any change in the health region's population between 1995 and 1997 (%).

Population size is the population of the health region as a proportion of the total Canadian population.

Average income includes average post-transfer, pre-tax personal income from all sources, for people aged 15 or older.

Government transfers includes payments from federal programs such as Guaranteed Income Supplement, Old Age Security, Canada/Québec Pension Plan, and Employment Insurance, expressed as a proportion of total income from all sources.

Unemployment was calculated by dividing the total number of unemployed individuals aged 15 or older by the total number of individuals aged 15 or older participating in the labour force.

Visible minority is the proportion of the health region's population belonging to a visible minority group.

Population density is the number of persons per square kilometre.

Immigration represents the proportion of individuals who came to Canada between 1981 and 1996.

Housing value is the average expected value of an owner-occupied, non-farm, non-reserve dwelling, including land, at the time of the 1996 Census.

Lone-parents families represents the proportion of lone-parent families, among all census families in the health region, living in private households.

Income equality was measured by calculating the total income for all households in the geographic area (health region), then calculating the proportion of this total household income for the less well-off 50% of households within that geographic area (that is, the "median share" of income). In a situation of complete inequality, the bottom half receives 0, and the top half 100%, of all income. With complete equality, the bottom half of the income distribution receives 50% of the total income and the geographic area then has a median share value of 0.50. In this range from 0 to 0.50, higher median shares indicate more equal income distributions.

Owner-occupied dwelling is the proportion of total private households in which the owner lives. Band housing and collective dwellings are excluded from both numerator and denominator.

Long life, good health

A long life and good health generally go hand in hand.[13,14] Life expectancy above the average for Canada is generally accompanied by DFLE that is also higher than the national value, and the converse is also true. This applies to the majority of health regions (72).

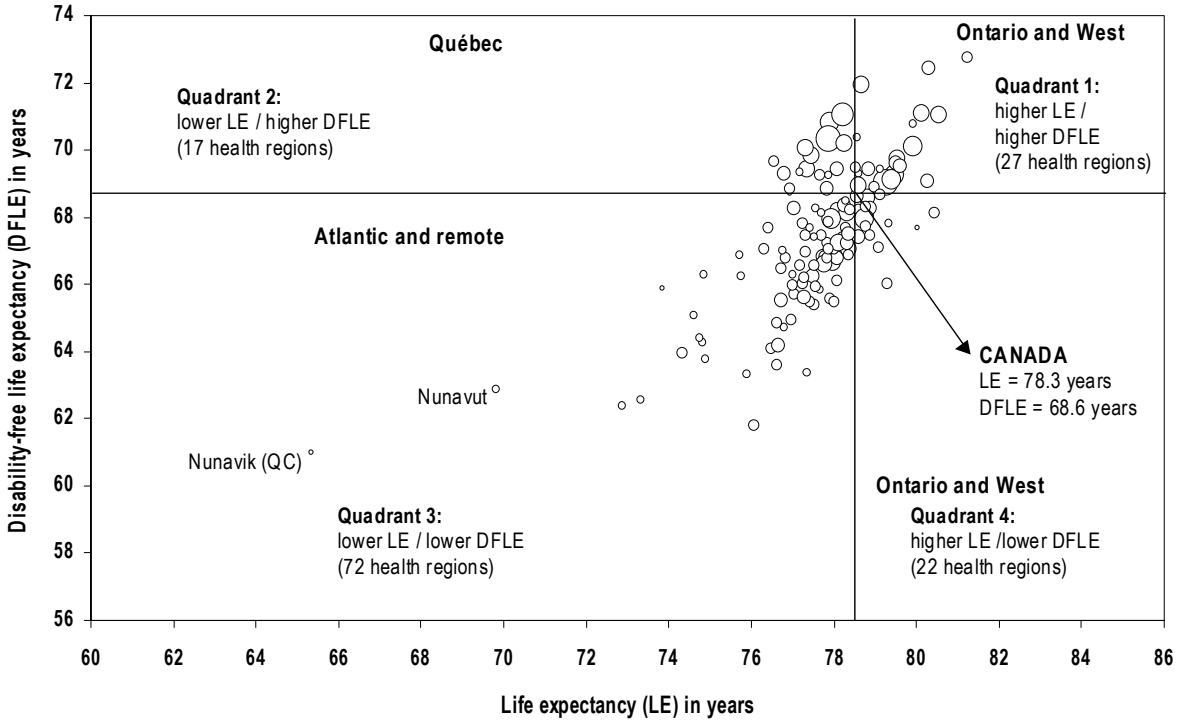
Presenting estimated life expectancy and DFLE for each of the 138 health regions in quadrants shows the relationship between the two indicators (Chart, Appendix Table A). Each circle represents a health region, and the centre of the circle represents the intersection of life expectancy and DFLE for the health region. The size of the circle is proportional to the square root of the population size. Quadrant 1 contains those health regions where life expectancy and DFLE were both higher than the corresponding national values. Quadrant 3 represents the opposite situation: life expectancy and DFLE both below the national values. The remaining Quadrants, 2 and 4, represent situations somewhere in the middle.

The highest DFLE values were most often found in major urban centres or the heavily populated suburbs close to them, and were less common in remote rural or northern regions.

Life expectancy, DFLE higher for "main street" regions

Ontario and the western provinces contain most of the health regions in which life expectancy and DFLE were high, compared with the corresponding national values (Chart, Quadrant 1). And these regions are generally either in major urban centres, or areas that are highly integrated with major urban centres. This reflects their "main street" status; that is, their high socio-economic status, high levels of immigration, and accessible health care services. It also reflects the robust economies of these regions.

Chart
Life expectancy (LE) and disability-free life expectancy (DFLE) at birth, by health region, both sexes, Canada, 1996



Data sources: *1996 Census of Population; 1995-1997 Canadian Vital Statistics Database; Demography Division population estimates; Reference 11*

However, in some health regions, life expectancy exceeded the national value, but DFLE was lower than the Canadian average (Quadrant 4). Almost all these regions are also in Ontario and the West, but they are located in, or on the periphery of, rural areas.

Atlantic region—life expectancy and DFLE lower

The least desirable situation, in which life expectancy and DFLE are lower than the national values (Quadrant 3), was most common in rural and northern regions far from major urban centres. This was true for the majority of health regions in the Atlantic provinces.

Health regions where life expectancy was low when compared with the national value, but DFLE was higher (Quadrant 2) were mainly found in Québec. This finding is explained by the low rates of major activity limitation in that province.

Magnitude of disparities important

The implications of the unequal distribution of life expectancy and DFLE by health region depend on the magnitude of those disparities. In some cases, life expectancy and DFLE differed sharply from national values. In Quadrant 1, both values surpassed the national level.

On the other hand, a number of health regions had life expectancy and DFLE well below corresponding national values (Quadrant 3). For example, Nunavik, which is part of this group, ranked last in terms of life expectancy (65.4 years) and DFLE (61.0 years): 12.9 and 7.6 years less than the corresponding national values.

Associated factors

Variations in disability-free life expectancy were examined using a linear regression model (see *Methods*). Four synthetic variables, representing 21 demographic and socio-economic variables, serve as variables possibly associated with DFLE: remote, prosperous, cosmopolitan, and disadvantaged (Appendix Table B).

Lower DFLE was associated with lower scores on the remote and disadvantaged synthetic variables, while higher DFLE was associated with higher scores on the prosperous and cosmopolitan synthetic variables (Table 2). Census indicators associated with the cosmopolitan synthetic variable include high levels of immigration and visible minorities, as well as high population density. The four factors account for 46% of the regional variation in DFLE.

These findings at the health region level reflect some now familiar relationships between health and socio-demographic characteristics at the individual level.[15] Low socio-economic position in Canada is generally associated with poor health outcomes and higher mortality.[16] Furthermore, the "healthy immigrant effect" has been observed in the past, and can be explained by such things as the tendency of ill persons to not immigrate, the medical screening that potential immigrants must undergo, and the fact that immigrant selection is partly based on employability, which implies good health.[17]

Table 2
Regression coefficients relating synthetic variables† to disability-free life expectancy, Canada, 1996

Synthetic variable†	Estimated regression coefficient	
Remote	-0.72	(< 0.01)
Prosperous	0.33	(0.02)
Cosmopolitan	0.87	(< 0.01)
Disadvantaged	-0.84	(< 0.01)
R^2	0.46	

Data sources: *1996 Census of Population; 1995-1997 Canadian Vital Statistics Database; Demography Division population estimates; Reference 11*
Notes: *The estimated value of a coefficient represents the change in DFLE for each increase of 1 standard deviation of that synthetic variable. The sign of the coefficient indicates the direction of the association between those two variables. The numbers in parentheses represent the lowest significance level at which the hypothesis of a zero coefficient can be rejected (p value). When the model was rerun without Nunavut and Nunavik, somewhat exceptional health regions, the explained variation was only marginally reduced and the factors maintained statistical significance. Burntwood and Churchill regions in Manitoba were combined because of small populations.*
† Summarizing 21 demographic and socio-economic variables (see Appendix Table B)
df = 133; F-statistic = 27.89 (p < 0.01)

Limitations

The 1996 Census questions on activity limitations were not designed to provide estimates of activity limitations. Rather, the questions were to be used to establish the sample for a post-censal survey on health and activity limitation. But since this survey was not conducted in 1996, the data on activity limitations from the 1996 Census were not verified to ensure that they were complete and consistent.

The census questionnaire was self-administered, so it is the respondents' perceptions of their own major activity limitations that were actually measured. No independent source verified these self-reported data, and the degree to which they are inaccurate because of reporting error is unknown. Nevertheless, self-reported health is a good predictor of mortality and the use of health care services.[18]

The regional-scale analysis of the determinants of DFLE made no attempt to account for aggregate indicators of behavioural risk factors such as smoking or obesity rates, nor were variations in health and health care policy or indicators of social cohesion considered. All of these might play a role in explaining some additional variation in DFLE, but they are unlikely to surpass the explanatory power of the socio-economic indicators.

In these analyses, "region" is an entity that represents more than the sum of individual inhabitants in the region. Regional DFLE estimates shown are aggregates across heterogeneous communities within the regions. The health-region scale, however, is a much finer scale with which to examine this population health indicator than has traditionally been possible in the Canadian context.

Concluding remarks

In 1996, the health regions of Ontario and the western provinces generally had life expectancy and disability-free life expectancy (DFLE) higher than the corresponding national values. Life expectancy tended to be lower—often considerably so—in remote rural and northern regions compared with major urban centres. As well, most health regions in the Atlantic provinces had life expectancies and DFLEs lower than the corresponding national values. In the majority of health regions in Québec, life expectancy was lower than the Canadian value. However, because perceived major activity limitation rates are much lower in that province than in the rest of the country, DFLE is generally high in Québec, compared with Canada as a whole.

A health region's indicators of socio-economic status explain a high proportion (46%) of the variation of DFLE by health region observed across Canada. This patterning of health by social indicators has been observed numerous times in Canada,[19-21] as well as elsewhere in the world.[13]

Despite Canada's universal health care system, considerable inequalities in health outcomes remain. Knowledge of the regional profile of health expectancy in Canada, the nature of the health disparities in the health regions and the magnitude of those disparities should make it possible to target those regions where the needs are most obvious and where intervention is a priority. Moreover, knowledge of the explanatory factors behind DFLE may inform decision-making, particularly by clarifying potential and desirable intervention tools. The magnitude of the disparities in disability-free life expectancy suggests that improvements may be possible in health regions for which estimates were the lowest, notably in the remote rural and northern regions. However, the relatively low rates of disability in Québec compared with the other provinces suggests that systematic differences in the evaluation of their health status may exist between various subsets of the Canadian population and may complicate the interpretation of regional variations in disability-free life expectancy indicators. ●

Acknowledgements

The authors thank Michel Séguin, Jason Gilmore, and Mike Tjepkema.

References

1 Robine J-M. L'espérance de vie sans incapacité. In: *Espérance de santé*, Robine J-M, Blanchet M, Dowd JE, eds. Paris: Les éditions INSERM, 1992: 1-45.

2 Ware JE Jr, Brook RH, Davies AR, et al. Choosing measures of health status for individuals in general populations. *American Journal of Public Health* 1981; 71: 620-5.

3 Sullivan DF. A single index of mortality and morbidity. *HSMSA Health Reports* 1971; 86: 347-54.

4 Chiang CL. *The Life Table and its Applications*. Malabar, Florida: Robert E. Krieger Publishing Company, 1984.

5 Wilkins R. Espérance de vie en santé au Québec et au Canada en 1986. *Cahiers québécois de démographie* 1991; 20(2): 367-82.

6 Wilkins R, Adams O, Brancker A. Changes in mortality by income in urban Canada from 1971 to 1986. *Health Reports* (Statistics Canada, Catalogue 82-003) 1989; 1(2): 137-74.

7 Mathers C. *Health Expectancies in Australia, 1981 and 1988*. Canberra: Australian Institute of Health/Australian Government Publishing Service, 1991.

8 Gutiérrez-Fisac JL, Gispert R, Solà J. Factors explaining the geographical differences in disability free life expectancy in Spain. *Journal of Epidemiology and Community Health* 2000; 54: 451-5.

9 Bone MR, Bebbington AC, Jagger C, et al. *Health Expectancy and its Uses*. London: Her Majesty's Stationery Office, 1995.

10 MacMillan HL, MacMillan AB, Offord DR, et al. Aboriginal health. *Canadian Medical Association Journal* 1996; 155: 1569-78.

11 Statistics Canada. *Health Indicators* (Catalogue no. 82-221-XIE) 2001; 2001(3). Available at http://www.statcan.ca.

12 Gilmore J, Wannell B. Life expectancy. *Health Reports* (Statistics Canada, Catalogue 82-003) 1999; 11(3): 9-24.

13 Robine J-M, Romieu I, Cambois E. Health expectancy indicators. *Bulletin of the World Health Organization* 1999; 77(2): 181-5.

14 Pampalon R, Choinière R, Rochon M. L'espérance de santé au Québec. *Enquête québécoise sur les limitations d'activité 1998*. Québec: Institut de la statistique du Québec, 2001.

15 Evans R, Barer M, et al. *Why are Some People Healthy and Others Not?* New York: Aldine deGruyter, 1994.

16 Wilkins R, Ng E, Berthelot J-M. *Trends in mortality by income in urban Canada from 1971 to 1996. Session 65: Cause of death analyses, differentials and trends.* Paper presented to Population Association of America, Washington, DC: March 2001.

17 Chen J, Wilkins R, Ng E. Health expectancy by immigrant status, 1986 and 1991. *Health Reports* (Statistics Canada, Catalogue 82-003); 1996: 8(3) 29-38.

18 Manuel DG, Schultz SE. Adding years to life and life to years: life and health expectancy in Ontario. *Atlas Reports: The Health of Ontarians, Report 1*. Toronto: Institute for Clinical Evaluative Sciences, 2001.

19 Wolfson MC. Health-adjusted life expectancy. *Health Reports* (Statistics Canada, Catalogue 82-003) 1996; 8(1): 41-6.

20 Wilkins R, Adams OB. Health expectancy in Canada, late 1970s: demographic, regional, and social dimensions. *American Journal of Public Health* 1983; 73(9): 1073-80.

21 Wilkins R, Mayer F, Ross N, et al. Health expectancy by neighbourhood income in urban Canada, using census disability data for 1996. Presented at REVES 13. Vancouver: June 2001.

Appendix

Table A
Four synthetic variables summarizing 21 demographic and socio-economic variables

Synthetic variable	% of total variance explained	Demographic and socio-economic variables with highest weights in synthetic variable (direction of association)
Remote	32	Male/Female ratio (+) Population < 15 (+) Aboriginal population (+) Strong metropolitan-influenced zone (-) Frost-free days (-) Housing inaffordability (-) Education 25-54 (-) Population ≥ 65 (-)
Prosperous	20	Internal migration (+) Population change (+) Average income (+) Government transfers (-) Unemployment (-)
Cosmopolitan	15	Visible minority (+) Population density (+) Immigration (+) Housing values (+) Population size (+)
Disadvantaged	6	Lone-parent families (+) Income equality (-) Owner-occupied dwelling (-)

Data sources: *1996 Census of Population; 1995-1997 Canadian Vital Statistics Database; Demography Division population estimates; Reference 11*
Note: *Signs between parentheses indicate direction of association between each synthetic variable and main demographic and socio-economic variables of which it is composed.*

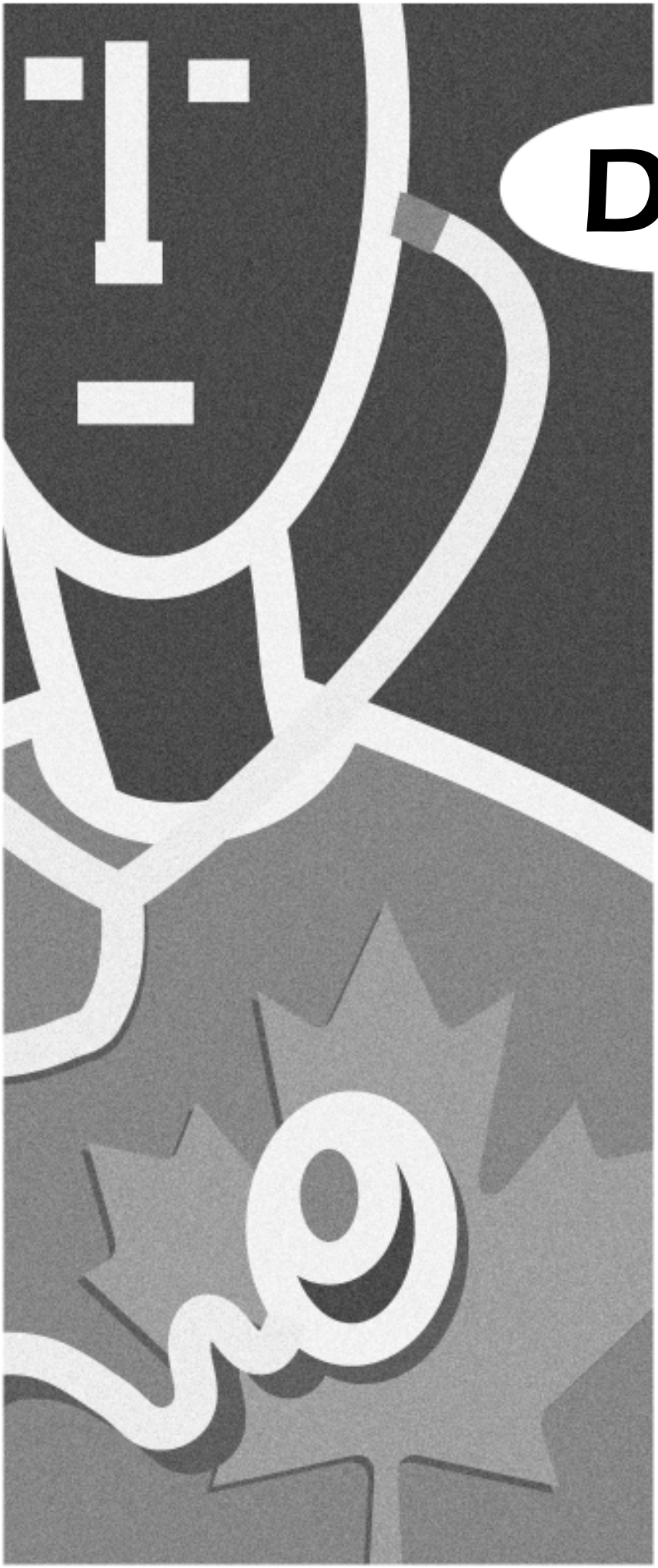
Table B
Life expectancy and disability-free life expectancy at birth, by health region, both sexes, Canada, 1996

Health region				Life expectancy (years)		Disability-free life expectancy (years)	
Number	Name	Type†	Quadrant	Estimate	95% confidence interval	Estimate	95% confidence interval
Canada				**78.3**	**78.3, 78.4**	**68.6**	**68.5, 68.6**
Newfoundland							
1001	St. John's	CHR	3	78.1	77.7, 78.5	68.2	67.8, 68.6
1002	Eastern	CHR	3	76.3	75.8, 76.8	67.0	66.6, 67.5
1003	Central	CHR	2	77.7	77.2, 78.1	69.2	68.8, 69.7
1004	Western	CHR	3	77.3	76.7, 77.8	67.8	67.2, 68.3
1005	Grenfell	CHR	2	78.3	77.0, 79.5	70.8	69.6, 72.0
1006	Labrador	HCO	3	74.9	73.3, 76.4	66.3	64.9, 67.7
Prince Edward Island							
1101	Urban	URA	3	77.0	76.4, 77.7	66.3	65.6, 66.9
1102	Rural	URA	1	79.1	78.5, 79.7	68.8	68.1, 69.4
Nova Scotia							
1201	Yarmouth	ZON	3	77.5	77.1, 78.0	65.4	64.9, 65.8
1202	Kentville	ZON	4	79.3	78.8, 79.8	66.0	65.5, 66.6
1203	Thuro	ZON	3	77.9	77.4, 78.4	65.6	65.1, 66.0
1204	New Glasgow	ZON	3	78.1	77.6, 78.6	66.1	65.6, 66.6
1205	Cape Breton	ZON	3	76.1	75.6, 76.5	61.8	61.4, 62.2
1206	Halifax	ZON	3	77.9	77.6, 78.1	66.8	66.5, 67.1
New Brunswick							
1301	Moncton	HRE	4	78.8	78.4, 79.2	68.1	67.7, 68.4
1302	Saint John	HRE	3	77.5	77.1, 77.9	66.3	65.9, 66.6
1303	Fredericton	HRE	3	77.8	77.3, 78.2	66.8	66.4, 67.2
1304	Edmundston	HRE	3	76.8	76.0, 77.6	64.7	64.0, 65.4
1305	Campbellton	HRE	3	77.4	76.4, 78.3	63.4	62.5, 64.3
1306	Bathurst	HRE	4	79.1	78.5, 79.7	67.1	66.5, 67.7
1307	Miramichi	HRE	3	77.7	76.9, 78.5	65.9	65.1, 66.6
Québec							
2401	Bas-Saint-Laurent	RSS	2	78.1	77.7, 78.5	69.4	69.1, 69.8
2402	Saguenay - Lac-Saint-Jean	RSS	2	76.8	76.5, 77.1	69.3	69.0, 69.6
2403	Québec	RSS	2	77.9	77.7, 78.1	70.8	70.6, 71.0
2404	Mauricie et Centre-du-Québec	RSS	2	77.4	77.1, 77.6	69.4	69.2, 69.7
2405	Estrie	RSS	2	77.9	77.5, 78.2	68.9	68.6, 69.2
2406	Montréal-Centre	RSS	2	77.9	77.7, 78.0	70.3	70.2, 70.4
2407	Outaouais	RSS	3	77.1	76.7, 77.4	68.3	68.0, 68.6
2408	Abitibi-Témiscamingue	RSS	3	76.4	76.0, 76.9	67.7	67.2, 68.1
2409	Côte-Nord	RSS	2	76.6	76.0, 77.1	69.7	69.1, 70.2
2410	Nord-du-Québec	RSS	2	76.9	75.2, 78.6	68.7	67.0, 70.5
2411	Gaspésie-Îles-de-la-Madeleine	RSS	2	76.9	76.4, 77.5	68.8	68.3, 69.3
2412	Chaudière-Appalaches	RSS	2	78.3	78.0, 78.5	70.2	69.9, 70.5
2413	Laval	RSS	1	78.7	78.4, 78.9	72.0	71.7, 72.2
2414	Lanaudière	RSS	2	77.5	77.2, 77.8	69.8	69.5, 70.1
2415	Laurentides	RSS	2	77.3	77.1, 77.6	70.0	69.8, 70.3
2416	Montérégie	RSS	2	78.2	78.1, 78.4	71.1	70.9, 71.2
2417	Nunavik	RSS	3	65.4	63.0, 67.7	61.0	58.8, 63.2
2418	Terres-Cries-de-la-Baie-James	RSS	3	73.9	71.9, 75.9	65.9	63.8, 67.9

Health region				Life expectancy (years)		Disability-free life expectancy (years)	
Number	Name	Type†	Quadrant	Estimate	95% confidence interval	Estimate	95% confidence interval
Ontario							
3526	Algoma	PHU	3	77.0	76.5, 77.5	64.9	64.5, 65.4
3527	Brant	PHU	3	77.6	77.1, 78.0	65.9	65.4, 66.4
3530	Durham PHU	PHU	4	78.3	78.1, 78.6	68.1	67.9, 68.4
3531	Elgin-St Thomas	PHU	3	77.1	76.5, 77.6	65.7	65.1, 66.3
3533	Bruce-Grey-Owen Sound	PHU	3	77.8	77.4, 78.2	67.2	66.8, 67.6
3534	Haldimand-Norfolk	PHU	3	77.8	77.3, 78.3	66.8	66.3, 67.3
3535	Haliburton-Kawartha-Pine Ridge	PHU	3	78.2	77.8, 78.6	67.2	66.8, 67.6
3536	Halton	PHU	1	80.1	79.9, 80.4	71.1	70.8, 71.4
3537	Hamilton-Wentworth	PHU	3	78.0	77.7, 78.2	66.6	66.4, 66.9
3538	Hastings-Prince Edward	PHU	3	77.4	77.0, 77.9	65.5	65.1, 65.9
3539	Huron	PHU	4	78.5	77.9, 79.2	68.2	67.6, 68.8
3540	Kent-Chatham	PHU	3	76.6	76.1, 77.1	64.9	64.4, 65.3
3541	Kingston-Frontenac-Lennox-Addington	PHU	3	78.1	77.7, 78.5	66.8	66.4, 67.1
3542	Lambton	PHU	3	78.3	77.9, 78.8	67.7	67.2, 68.1
3543	Leeds-Grenville-Lanark	PHU	3	77.2	76.8, 77.6	66.5	66.1, 66.9
3544	Middlesex-London	PHU	4	78.4	78.1, 78.6	67.0	66.8, 67.3
3545	Muskoka-Parry Sound	PHU	3	77.3	76.6, 77.9	66.0	65.4, 66.6
3546	Niagara	PHU	3	78.3	78.0, 78.5	67.3	67.1, 67.5
3547	North Bay	PHU	3	76.6	76.1, 77.2	63.6	63.1, 64.1
3549	Northwestern	PHU	3	74.3	73.7, 75.0	63.9	63.3, 64.6
3551	Ottawa Carleton	PHU	1	79.5	79.3, 79.7	69.2	69.0, 69.4
3552	Oxford	PHU	3	78.0	77.5, 78.5	67.0	66.5, 67.5
3553	Peel	PHU	1	79.9	79.7, 80.1	70.1	69.9, 70.3
3554	Perth	PHU	1	78.7	78.1, 79.3	68.6	68.0, 69.2
3555	Peterborough	PHU	4	78.4	77.9, 78.8	66.9	66.4, 67.3
3556	Porcupine	PHU	3	76.5	75.9, 77.0	64.1	63.6, 64.6
3557	Renfrew	PHU	3	78.0	77.5, 78.5	65.5	65.0, 66.0
3558	Eastern Ontario	PHU	3	77.3	76.9, 77.7	65.6	65.2, 66.0
3560	Simcoe	PHU	3	78.1	77.8, 78.4	67.2	66.9, 67.5
3561	Sudbury	PHU	3	76.7	76.3, 77.0	64.2	63.8, 64.5
3562	Thunder Bay	PHU	3	76.7	76.3, 77.1	65.5	65.1, 65.9
3563	Timiskaming	PHU	3	75.9	75.0, 76.7	63.3	62.5, 64.1
3565	Waterloo	PHU	1	78.8	78.6, 79.1	68.6	68.3, 68.8
3566	Wellington-Dufferin-Guelph	PHU	1	78.8	78.5, 79.2	69.4	69.1, 69.8
3568	Windsor-Essex	PHU	3	77.8	77.5, 78.0	66.6	66.3, 66.9
3570	York	PHU	1	80.6	80.3, 80.8	71.1	70.8, 71.3
3595	City of Toronto	PHU	1	79.3	79.2, 79.4	69.0	68.9, 69.1
Manitoba							
4610	Winnipeg	HRE	3	77.9	77.7, 78.2	68.0	67.8, 68.2
4615	Brandon	HRE	4	79.3	78.6, 80.1	67.8	67.1, 68.6
4620	North Eastman	HRE	3	77.6	76.6, 78.6	68.3	67.3, 69.2
4625	South Eastman	HRE	1	79.3	78.6, 80.1	69.3	68.5, 70.0
4630	Interlake	HRE	3	77.3	76.7, 78.0	67.4	66.8, 68.1
4640	Central	HRE	1	79.0	78.4, 79.5	68.9	68.4, 69.4
4650	Marquette	HRE	2	77.9	76.9, 78.8	69.3	68.4, 70.1
4655	South Westman	HRE	2	77.2	76.3, 78.1	69.3	68.5, 70.2
4660	Parkland	HRE	3	77.4	76.6, 78.3	67.7	66.9, 68.5
4670	Norman	HRE	3	74.6	73.5, 75.8	65.1	64.0, 66.2
4680/4690	Burntwood and Churchill‡	HRE	3	72.9	71.7, 74.0	62.4	61.3, 63.4
Saskatchewan							
4701	Weyburn (A)	SAR	1	79.1	78.4, 79.8	69.4	68.8, 70.1
4702	Moose Jaw (B)	SAR	4	78.7	78.0, 79.5	68.2	67.5, 68.8
4703	Swift Current (C)	SAR	1	79.9	79.1, 80.7	70.8	70.0, 71.5
4704	Regina (D)	SAR	3	78.3	77.9, 78.6	68.4	68.0, 68.7
4705	Yorkton (E)	SAR	3	78.3	77.6, 78.9	68.5	67.8, 69.1

Health region				Life expectancy (years)		Disability-free life expectancy (years)	
Number	Name	Type†	Quadrant	Estimate	95% confidence interval	Estimate	95% confidence interval
4706	Saskatoon (F)	SAR	4	78.9	78.5, 79.2	68.3	67.9, 68.6
4707	Rosetown (G)	SAR	1	78.6	77.9, 79.3	70.4	69.7, 71.1
4708	Melfort (H)	SAR	1	78.6	77.8, 79.4	69.3	68.5, 70.1
4709	Prince Albert (I)	SAR	4	78.4	77.7, 79.1	67.2	66.6, 67.9
4710	North Battleford (J)	SAR	3	77.3	76.6, 78.0	66.9	66.2, 67.6
4711	Northern (K)	HSB	3	73.3	72.0, 74.7	62.5	61.3, 63.8
Alberta							
4801	Chinook	RHA	3	77.7	77.2, 78.2	67.4	67.0, 67.9
4802	Palliser	RHA	1	79.1	78.5, 79.7	68.7	68.1, 69.3
4803	Headwaters	RHA	1	78.5	77.9, 79.2	69.5	68.8, 70.1
4804	Calgary	RHA	1	79.4	79.2, 79.6	69.1	68.9, 69.3
4805	Crowfoot-Wild Rose	RHA	3	77.7	76.9, 78.5	68.1	67.4, 68.9
4806	David Thompson	RHA	4	78.3	77.9, 78.8	67.2	66.8, 67.6
4807	East Central	RHA	4	78.6	78.1, 79.2	68.2	67.7, 68.7
4808	WestView	RHA	4	80.4	79.7, 81.1	68.1	67.4, 68.8
4809	Crossroads	RHA	3	74.8	73.8, 75.8	64.3	63.4, 65.2
4810	Capital	RHA	4	78.8	78.6, 79.0	68.0	67.8, 68.1
4811	Aspen	RHA	4	78.8	78.2, 79.4	67.7	67.1, 68.3
4812	Lakeland	RHA	3	77.0	76.5, 77.5	66.0	65.4, 66.5
4813	Mistahia	RHA	3	77.5	76.9, 78.2	66.6	65.9, 67.2
4814	Peace	RHA	3	74.9	73.5, 76.2	63.8	62.6, 65.0
4815	Keeweetinok Lakes	RHA	3	74.8	73.3, 76.2	64.4	63.0, 65.8
4816	Northern Lights	RHA	3	75.8	74.3, 77.3	66.3	64.9, 67.6
4817	Northwestern	RHA	4	80.0	77.9, 82.1	67.7	65.5, 69.8
British Columbia							
5901	East Kootenay	HRE	4	78.8	78.1, 79.4	68.3	67.7, 68.9
5902	West Kootenay-Boundary	HRE	3	77.9	77.2, 78.5	66.8	66.2, 67.4
5903	North Okanagan	HRE	4	78.9	78.4, 79.4	67.4	66.9, 67.9
5904	South Okanagan Similkameen	HRE	1	80.3	79.9, 80.6	69.1	68.7, 69.4
5905	Thompson	HRE	3	77.3	76.8, 77.8	66.2	65.7, 66.7
5906	Fraser Valley	HRE	4	78.6	78.3, 79.0	67.4	67.1, 67.8
5907	South Fraser Valley	HRE	1	79.6	79.3, 79.8	69.7	69.5, 70.0
5908	Simon Fraser	HRE	1	78.6	78.3, 78.9	68.6	68.3, 68.9
5909	Coast Garibaldi	HRE	4	78.4	77.8, 79.0	68.2	67.6, 68.9
5910	Central Vancouver Island	HRE	4	78.4	78.0, 78.7	67.5	67.1, 67.8
5911	Upper Island/Central Coast	HRE	3	77.9	77.3, 78.4	67.9	67.3, 68.4
5912	Cariboo	HRE	3	76.7	76.0, 77.5	66.5	65.8, 67.1
5913	North West	HRE	3	77.9	77.2, 78.6	67.1	66.4, 67.7
5914	Peace Liard	HRE	3	77.5	76.7, 78.4	67.4	66.6, 68.2
5915	Northern Interior	HRE	3	76.8	76.3, 77.4	66.8	66.2, 67.3
5916	Vancouver	HRE	1	78.6	78.4, 78.8	68.9	68.7, 69.2
5917	Burnaby	HRE	1	79.5	79.1, 79.9	69.6	69.2, 70.0
5918	North Shore	HRE	1	80.3	80.0, 80.7	72.5	72.1, 72.8
5919	Richmond	HRE	1	81.2	80.8, 81.7	72.8	72.3, 73.2
5920	Capital	HRE	1	79.6	79.4, 79.9	69.5	69.2, 69.8
Territories							
6001	Yukon	HRE	3	75.7	74.5, 77.0	66.9	65.6, 68.1
6101	Northwest	HRE	3	76.8	75.5, 78.1	67.0	65.8, 68.2
6201	Nunavut	HRE	3	69.8	68.2, 71.5	62.9	61.3, 64.5

Data sources: *1996 Census of Population; 1995-1997 Canadian Vital Statistics Database; Demography Division population estimates; Reference 11*
† CHR=Community Health and Social Services Region; HCO=Health Corporation; URA=Urban or rural area; ZON=Health Zone; HRE=Health Region; RSS=Région socio-sanitaire; PHU=Public Health Unit; SAR=Service Area; HSB=Health Services Branch; RHA=Regional Health Authority
‡ Burntwood and Churchill regions in Manitoba were combined because of small populations.



Data Releases

Synopses of recent health information produced by Statistics Canada

Therapeutic abortions, 1999

A total of 65,627 therapeutic abortions were reported for Canada in 1999. The 1999 data include the territories and all provinces except Ontario.

Because Ontario accounts for about 40% of all abortions, data for this province have a major impact on the national picture. Therefore, to make comparisons with the previous year, Ontario figures were subtracted from the 1998 level.

The therapeutic abortion rate is based on therapeutic abortions performed in hospitals and clinics outside Ontario, and legal abortions obtained in the United States. Between 1998 and 1999, the abortion rate (excluding Ontario) declined from 32.3 for every 100 live births to 31.8. Abortion rates decreased in each territory and province, except Newfoundland and Manitoba.

Over half (52%) of women who obtained an abortion in 1999 were in their twenties. On average, 27 out of every 1,000 women in their twenties obtained an abortion.

Selected tables for 1995 through 1999 are available in the "Canadian Statistics" module of Statistics Canada's Web site @ www.statcan.ca. Therapeutic abortion data for 1999 were collected by the Canadian Institute for Health Information (CIHI). For more information, contact CIHI (telephone: 416-481-2002, ext. 3523; fax: 416-481-2950).

Cancer incidence, 1999 (preliminary)

Cancer incidence data for 1999 (new cases diagnosed in 1999 as reported by the provincial and territorial cancer registries) are now available for the provinces and territories except Ontario and Québec. Cancer incidence data at the national level are available for 1996.

For more information, or to enquire about the concepts, methods or data quality of this release, contact Michel Cormier (613-951-1775) or the Client Custom Services Unit (613-951-1746), Health Statistics Division.

Health Indicators 3, 2001

The third version of *Health Indicators*, a Web-based data publication produced by Statistics Canada and the Canadian Institute for Health Information, is now available. This set of indicators, which is based on standard definitions and methods, was designed to provide comparable information at the national, provincial/territorial and health region levels.

Four types of indicators are presented: health status (including health conditions, mortality rates and measures of well-being); non-medical determinants (socio-economic characteristics and health behaviours); health system performance (measures of accessibility, appropriateness and effectiveness of health care services); and community and health system characteristics (contextual information).

This latest edition of *Health Indicators* contains new highlights, maps and tables for a number of health indicators; for example, potential years of life lost and deaths caused by medically treatable diseases. In addition, it contains highlights and tables from previous editions.

For the first time, *Health Indicators* offers links between the Statistics Canada website and the Canadian Institute for Health Information website, enabling users to access all data sources for health indicators in a single, free, online publication.

Health Indicators, Volume 2001, no. 3 (82-221-XIE, free) is now is available on Statistics Canada's Web site (www.statcan.ca). For more information, contact Jason Gilmore (613-951-7118; jason.gilmore@statcan.ca), Health Statistics Division, Statistics Canada, or Anick Losier (613-241-7860), Canadian Institute for Health Information.

Subject Index

Subject Index Volumes 9 to 13

A

Abdominal aortic aneurysm

Aboriginal Peoples

Abortion

See also Miscarriage

Accidents

Adolescents

See Youths

Aging

See also Seniors

Alcohol

Alternative care

Arthritis

Asthma

Athletic injuries

Automobile driving

B

Births

See also Low birth weight
Pregnancy

C

Cancer

Cardiovascular disease

Care-giving

See Social support

Cause of death

See also Deaths

Cesarean section

Children

See also Youths

Chronic conditions

See also Arthritis
Asthma
Cancer
Cardiovascular disease
Depression
Diabetes
Hypertension
Stroke

Contraception

D

Data collection

See also Health surveys

Deaths

See also Cause of death

Dental care

Dependency

See also Social support

Depression

See also Mental health

Diabetes

Disability

Divorce

E

Exercise

F

Fractures

Functional health

H

Health care

See also Hospitalization
Hospitals
Nursing
Outpatient treatment
Physicians
Regional health
Residential facilities

Health insurance

Health services accessibility

Health status indicators

See also Life expectancy

Health surveys

See also Data collection

Home care

Hormone replacement therapy

Hospitalization

Hospitals

See also Residental facilities

Hysterectomy

I

Income

Injuries

See Accidents

L

Life expectancy

See also Health status indicators

Lone parents

The health of lone mothers. Pérez CE, Beaudet MP. 1991; 11(2): 21-32.

Low birth weight

Birth outcome, the social environment and child health. Chen J, Millar WJ. 1999; 10(4): 57-67.

Health status of children. Statistics Canada. 2000; 11(3): 25-34.

Infant mortality and low birthweight, 1975 to 1995. Nault F. 1998; 9(3): 39-46.

Maternal education and fetal and infant mortality in Quebec. Chen J, Fair M, Wilkins R, et al. 1998; 10(2): 53-64.

Maternal education and risk factors for small-for-gestational age births. Millar WJ, Chen J. 1998; 10(2): 43-51.

The risks of childbearing at older ages. MacNab YC, Macdonald J, Tuk TA. 1997; 9(2): 41-50.

M

Mammography

Who doesn't get a mammogram? Gentleman JF, Lee J. 1997; 9(1): 19-28.

Mass screening

Falling short of Pap test guidelines. Lee J, Parsons GF, Gentleman JF. 1998; 10(1): 9-19.

Who doesn't get a mammogram? Gentleman JF, Lee J. 1997; 9(1): 19-28.

Medical records

See Data collection
Health surveys

Medical record linkage

Revascularization and heart attack outcomes. Johansen H, Nair C, Mao L, et al. 2002; 13(2): 35-46.

Suicide deaths and suicide attempts. Langlois S, Morrison P. 2002; 13(2): 9-22.

Medication use

Characteristics of women on hormone replacement therapy. Beaudet MP, Walop W, Le Petit C. 1997; 9(2): 9-18.

Disparities in prescription drug insurance coverage. Millar WJ. 1999; 10(4): 11-31.

Health care/Self-care in *The Health Divide—How the Sexes Differ.* Statistics Canada. 2001; 12(3): 33-9.

Health care services—recent trends. Statistics Canada. 2000; 11(3): 91-109.

Hormone replacement therapy and incident arthritis. Wilkins K. 1999; 11(2): 49-57.

Medications and fall-related fractures in the elderly. Wilkins K. 1999; 11(1): 45-53.

Multiple medication use among seniors. Millar WJ. 1998; 9(4): 11-7.

Oral contraceptive use. Wilkins K, Johansen H, Beaudet MP, et al. 2000; 11(4): 25-37.

Mental health

See also Depression
Stress, psychological

Health care/Self-care in *The Health Divide—How the Sexes Differ.* Statistics Canada. 2001; 12(3): 33-9.

The health of lone mothers. Pérez CE, Beaudet MP. 1991; 11(2): 21-32.

Living at home or in an institution: What makes the difference for seniors? Trottier H, Martel L, Houle C, et al. 2000; 11(4): 49-61.

Psychological health—depression. Statistics Canada. 2000; 11(3): 63-75.

Shift work and health. Shields M. 2002; 13(4): 11-33.

Work stress and health. Wilkins K, Beaudet MP. 1999; 10(3): 47-62.

Migraine

Migraine. Gilmour H, Wilkins K. 2001; 12(2): 23-40.

Miscarriage

See also Abortion

Mortality
See Deaths

N

Neoplasms
See Cancer

Northern residents

Nursing homes
See Residential facilities

Nutrition

O

Occupational health

Outpatient treatment
See Health care

P

Pain

Physicians

Pregnancy
See also Births

Preventive health

R

Regional health

See also Health care

Residential facilities

See also Hospitals

S

Safety equipment

Seasonality

Seniors

See also Aging

Smoking

Social support

See also Dependency

Spontaneous abortion

See Miscarriage

Stress, psychological

See also Mental health

Suicide

Surgery

Survival rates

T

Therapeutic abortion

See Abortion

U

United States

V

Vital statistics

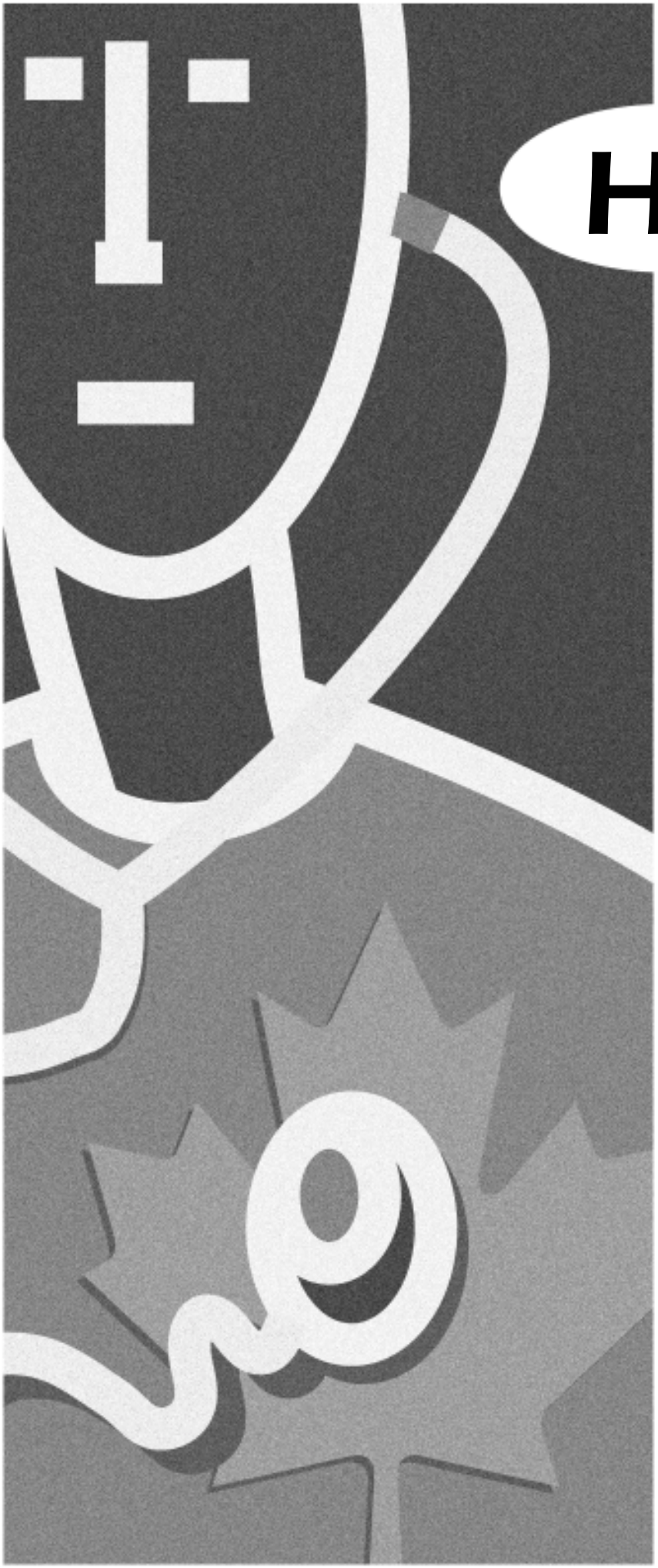
See also Births
Deaths
Divorce
Marriage

W

Weight

Y

Youths



How to Order

An inventory of Health Statistics Division's information products and services, including publications (print, diskette, microfiche or Internet), microdata files and special tabulations

To order the products listed below, contact:

Marketing Division, Sales and Service
Statistics Canada
Ottawa, Ontario
K1A 0T6
Telephone: (613) 951-7277
1-800-267-6677, toll free in Canada
Fax: (613) 951-1584,
or visit our site on the Internet: www.statcan.ca

Title		Catalogue number	Format	Price (CAN$)†‡
Health Reports	· subscription · single issue	82-003-XPE	Paper	$ 58 $ 20
	· subscription · single issue	82-003-XIE	Internet	$ 44 $ 15
Health Indicators, electronic publication		82-221-XIE	Internet	Free
Health Statistics at a Glance *(Replaced by Health Indicators, electronic publication)*		82F0075XCB	CD-ROM	$100
Health Regions 2000 – Boundaries, Geographic Information and Population Estimates		82F0082XCB	CD-ROM	$ 60
Guide to Health Statistics *(This provides quick and easy access to health information on Statistics Canada's web site. It can only be used online in html format and cannot be downloaded.)*		82-573-GIE	Internet	Free
Statistical Report on the Health of Canadians		82-570-XIE	Internet	Free
Report on Smoking Prevalence in Canada, 1985 to 1999		82F0077XIE	Internet	Free
Health Care in Canada 2000 – A First Annual Report		82-222-XIE (and http://www.cihi.ca)	Internet	Free
Cancer				
Cancer Incidence in Canada *(For 1994 to 1996, available through Client Custom Services Unit)*				
Cancer Record, Newsletter for Cancer Registries in Canada		82F0081XIB	Internet	Free
Heart Disease				
The Changing Face of Heart Disease and Stroke in Canada		82F0076XIE	Internet	Free
Hospitalization				
Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures and Treatments		82-562-XPB	Paper	$ 40
Life Expectancy				
Life Tables, Canada, Provinces and Territories, 1995-1997*		84-537-XIE	Internet	$ 15
Life Tables, Canada and Provinces, 1990-1992		84-537-XPB	Paper	$ 40
		84-537-XDB	Diskette	$ 40

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

Title	Catalogue number	Format	Price (CAN$)†‡
National Population Health Survey			
National Population Health Survey Overview 1994-95	82-567-XPB 82-567-XIB	Paper Internet	$ 10 $ 8
National Population Health Survey Overview 1996-97	82-567-XPB 82-567-XIB	Paper Internet	$ 35 $ 26
User's guide for the public use microdata file			
National Population Health Survey 1998-99 - Household Component	82M0009GPE	Paper	$ 50
National Population Health Survey 1996-97 - Household Component	82M0009GPE	Paper	$ 50
National Population Health Survey 1996-97 - Health Care Institutions	82M0010GPE	Paper	$ 50
Information about the National Population Health Survey *(See also section on Microdata files)*	82F0068XIE	Internet	Free
Nursing			
Registered Nurses Management Data 1998, Shelf Table *(This shelf table can be ordered through the Client Custom Services Unit.)*	83F0005XPB	Paper	$ 25
Occupational Surveillance			
Occupational Surveillance in Canada: Cause-specific mortality among workers, 1965-1991	84-546-XCB	CD-ROM	$500
Residential Care			
Residential Care Facilities, 1997-98 *(These data are available as custom tabulations through the Client Custom Services Unit.)*			
Vital Statistics			
Shelf tables			
Health Statistics Division produces shelf tables for the following, from data year 1996.			
General Summary of Vital Statistics	84F0001XPB	Paper	$ 20
Causes of Death	84F0208XPB	Paper	$ 20
Mortality - Summary List of Causes	84F0209XPB	Paper	$ 20
Mortality - Summary List of Causes, 1997	84F0209XIB	Internet	Free
Births	84F0210XPB	Paper	$ 20
Deaths	84F0211XPB	Paper	$ 20
Marriages	84F0212XPB	Paper	$ 20
Divorces	84F0213XPB	Paper	$ 20
Leading Causes of Death	84F0503XPB	Paper	$ 20
(These shelf tables can be ordered through the Client Custom Services Unit.)			
Other			
Validation study for a record linkage of births and deaths in Canada	84F0013XIE	Internet	Free
Postal Code Conversion File Plus (PCCF+) *(To obtain the PCCF+, clients must have purchased the PCCF)*	82F0086XDB	Diskette	Free
Historical Information			
Vital Statistics Compendium, 1996	84-214-XPE 84-214-XIE	Paper Internet	$ 45 $ 33

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

Health Statistics Division provides a custom tabulation service to meet special resource needs and supplement published data on a fee-for-service basis. Custom tables can be created using a variety of health and vital statistics data sources maintained by the Division.

To order custom tabulations, contact:

Client Custom Services Unit
Health Statistics Division
Statistics Canada
Ottawa, Ontario
K1A 0T6
Telephone: (613) 951-1746
Fax: (613) 951-0792
Email: HD-DS@statcan.ca

Microdata Files

To order the products listed below, contact:

Client Custom Services Unit
Health Statistics Division
Statistics Canada
Ottawa, Ontario
K1A 0T6
Telephone: (613) 951-1746
Fax: (613) 951-0792
Email: HD-DS@statcan.ca

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

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

Canadian Community Health Survey (CCHS)

A new survey, the Canadian Community Health Survey (CCHS), is being conducted by Statistics Canada to provide regular and timely cross-sectional estimates of health determinants, health status and health system utilization for 136 health regions across the country.

The following products are available:
- Health Indicators, updated to include estimates based on CCHS data for 136 health regions
- CANSIM II, including approximately 40 cross-tabulations by health region and province. All CANSIM tables will be accessible through Health Indicators and will be available free of charge.
- Custom tabulations of CCHS data, available on request on a cost-recovery basis.

A public-use CCHS microdata file is planned for release later in the year.

For more information about this survey, visit our web site at http://www. statcan.ca, under "Statistical Methods," followed by "New surveys."

National Population Health Survey (NPHS) Questionnaires

- Household
- Institutions
- North

The NPHS questionnaires are downloadable from Statistics Canada's website at http://www.statcan.ca, under "Statistical methods," followed by "Questionnaires" and "National Population Health Survey" (NPHS).

Canadian Statistics

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

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

Statistical Research Data Centres

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