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- Smoking-related disease
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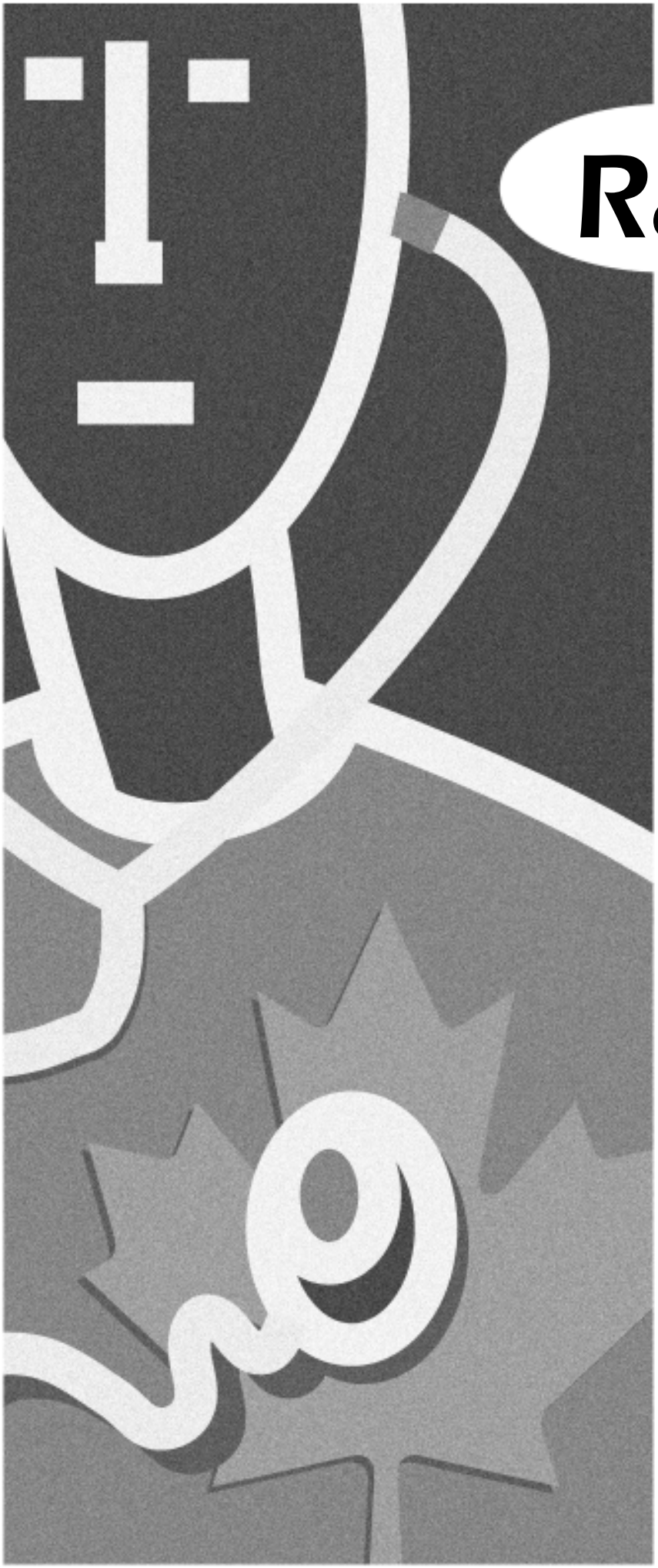

Research Articles

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

Age at diagnosis of smoking-related disease

Jiajian Chen

Abstract

Objectives

This study assesses the relationship between the age of daily smoking initiation and the age at diagnosis of chronic obstructive pulmonary disease (COPD), heart disease and rheumatoid arthritis.

Data source

The data are from the 2000/01 Canadian Community Health Survey (CCHS). The sample for the analysis consisted of 34,144 respondents aged 35 to 64 living in private households in the provinces and territories.

Analytical techniques

The life table approach was used to estimate the cumulative incidence of smoking-related disease. Cox proportional hazards regression models were used to estimate the relative risks of disease by the age when daily smoking began.

Main results

For both sexes, the younger the individuals were when they became daily smokers, the sooner they were diagnosed with COPD, heart disease or rheumatoid arthritis. Even when education, household income and number of cigarettes smoked per day were taken into account, adolescent starters were at increased risk of these diseases, compared with never-smokers.

Key words

chronic obstructive pulmonary disease, heart disease, rheumatoid arthritis, adolescent behaviour

Author

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Cigarette smoking is recognized as the single most preventable cause of debilitating illness and premature death.[1] While smoking usually begins in adolescence or early adulthood, associated diseases and death typically occur much later in life.[2] It has been suggested, however, that there may be a relationship between the age when smoking begins and the age at which such diseases are diagnosed.[3] Specifically, the earlier the initiation of smoking, the earlier the development of certain health problems.

This article uses data from the 2000/01 Canadian Community Health Survey (CCHS) to assess the relationship between the age when daily smoking began and the age at which three diseases were diagnosed: chronic obstructive pulmonary disease (COPD), heart disease and rheumatoid arthritis (see *Methods, Definitions* and *Limitations*). Daily smokers aged 35 to 64 are compared with their contemporaries who had never smoked. The smokers are divided into two groups according to the age at which they became daily smokers: 13 to 17 (adolescence) and 18 to 22 (young adulthood).

Studies of sex differences in the effects of smoking are inconclusive, but some recent research suggests that women may be more susceptible than men.[4-11] Accordingly, results are presented separately for men and women.

Early smoking/High disease prevalence

Of the 15,517 male respondents aged 35 to 64 (an estimated 3.3 million) in the analysis, 34% were daily smokers who had started smoking daily at ages 13 to 17, and 20% were daily smokers who had begun

Methods

Data source

The data are based on cycle 1.1 of Statistics Canada's 2000/01 Canadian Community Health Survey (CCHS). Data collection for this cycle 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 Statistics Canada's Labour Force Survey as its primary sampling frame. A multistage stratified cluster design was used to sample dwellings in 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 dialling (RDD) technique 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 chosen at random. The response rate was 84.7%. The responding sample size for cycle 1.1 was 131,535; 6.6% of interviews were obtained by proxy.[12]

Analytical techniques

This analysis focuses on three diseases: chronic obstructive pulmonary disease (COPD), heart disease and rheumatoid arthritis. The incidence of each was examined among respondents aged 35 to 64 (when they were interviewed) who had not been diagnosed with that disease by age 25. Three groups were compared: current daily smokers who began daily smoking at ages 13 to 17, current daily smokers who started at ages 18 to 22, and lifetime never-smokers.

The 35-to-64 age range was chosen because of the low prevalence of the three diseases at younger ages, and to reduce potential biases stemming from attrition due to mortality or institutionalization among seniors. The two age-at-initiation groups, 13 to 17 and 18 to 22, were selected because they are the ages at which daily smoking typically begins.[13]

The analysis excluded respondents who had stopped daily smoking for more than five years before the survey (14,492) because their duration of smoking was uncertain, and lifetime occasional smokers (9,915) because of the lack of information about when they started or stopped occasional smoking. A small number (149) of respondents who reported that they had started to smoke daily before the age that they reported smoking their first whole cigarette were also excluded. A sample of 34,144 respondents aged 35 to 64 remained for analysis: 15,517 men and 18,627 women (Appendix Table A).

Standard life-table methods were used to retrospectively estimate the cumulative incidence of being diagnosed with each of the three diseases (see *Definitions*). The cumulative incidence was estimated with the SAS LIFETEST procedure.[14] Respondents who had not been diagnosed with one of these diseases were considered censored at the age when they were interviewed.

Cox proportional hazards regression models[15] were used to estimate hazard ratios for being diagnosed with the diseases according to age at smoking initiation. The models included household income, education, and number of cigarettes smoked per day. The estimates were obtained using the PHREG in SAS.[14] Because of possible sex differences in smoking effects, separate models were fitted for men and women.

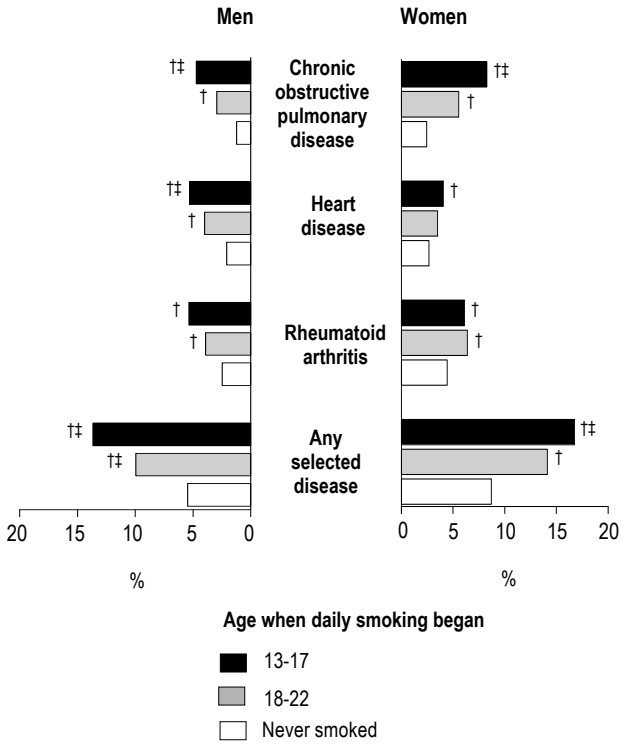
All analyses were based on weighted data. The standard errors of regression coefficients were estimated using the bootstrap technique to fully account for the sample weights and the complex survey design.[16]

at ages 18 to 22; the remaining 46% had never smoked. The corresponding proportions among the 18,627 female respondents (an estimated 3.7 million) were 23%, 18%, and 59% (Appendix Table A).

The potential health consequences of becoming a daily smoker at an early age are evident in the prevalence of three smoking-related diseases. In 2000/01, the prevalence of chronic obstructive pulmonary disease (COPD), heart disease and rheumatoid arthritis among these 35- to 64-year-olds was significantly higher for smokers than for people who had never smoked, and tended to be highest among those who had started smoking daily in adolescence (Chart 1).

Possible health effects of adolescent smoking are also evident in the incidence of these diseases. Among people who had been free of COPD, heart disease and rheumatoid arthritis at age 25, those who started smoking daily in adolescence tended to have been diagnosed earlier in life than those who had started smoking daily in young adulthood or those who were non-smokers.

Chart 1
Prevalence of selected smoking-related diseases, by sex and age when daily smoking began, household population aged 35 to 64, Canada, 2000/01



Data source: *2000/01 Canadian Community Health Survey, Cycle 1.1*
† Significantly different from "Never smoked" ($p < 0.05$)
‡ Significantly different from those who began daily smoking at ages 18 to 22 ($p < 0.05$)

Chronic obstructive pulmonary disease

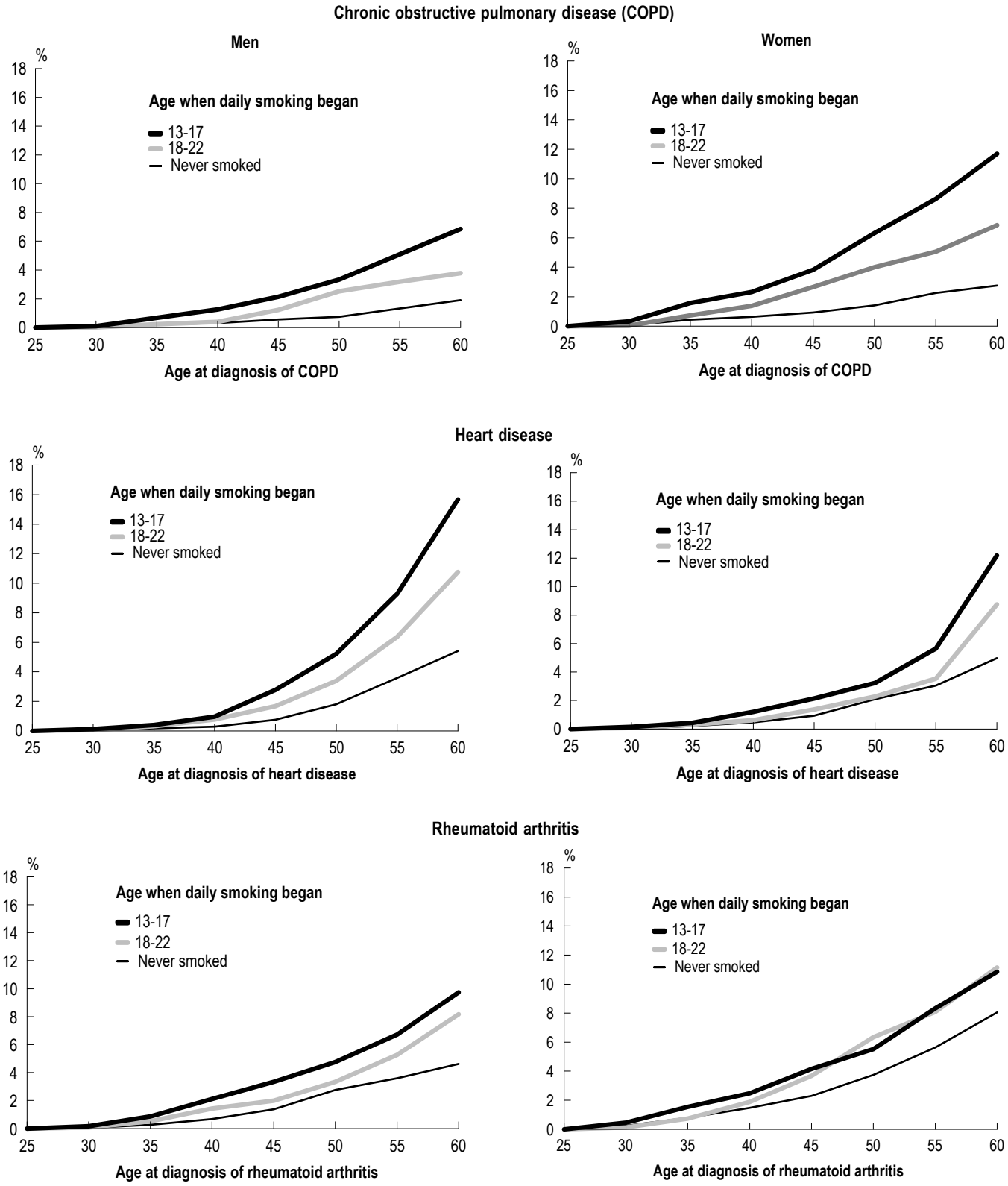
By the time they were in their thirties, the proportions of people with COPD began to diverge, depending on their smoking history. The cumulative incidence of the disease was higher among smokers than among never-smokers (Chart 2). And among smokers, a higher percentage of adolescent starters than young adult starters had been diagnosed.

By age 60, 7% of male and 12% of female adolescent starters had been diagnosed with COPD. The figures for young adult starters were lower: 4% of men and 7% of women. Just 2% of men and 3% of women who had never smoked had COPD at age 60.

Of course, adolescent starters had, on average, been smoking daily five years longer than young adult starters, which might explain the discrepancy by age 60. Even so, the cumulative incidence of COPD among adolescent starters surpassed that among young adult starters by more than the five-year age difference. For example, *by age 55,* over 5% of male adolescent starters had COPD, but *by age 60,* young adult starters had not completely narrowed the gap, as less than 4% had the disease. There was a similar difference among women: *by age 55,* 9% of adolescent starters had COPD, whereas *by age 60*, the figure for young adult starters was 7%. This indicates that with the same duration of smoking, adolescent starters were at increased risk of developing COPD, compared with young adult starters.

At each age, the cumulative incidence of COPD was higher among women. Since women are less likely than men to smoke heavily, regardless of how old they were when they started, the difference may indicate a greater vulnerability.[17] In fact, consistent with a previous study, even among never-smokers there was a sex gap in the cumulative incidence of COPD, although it was much narrower.

Chart 2
Cumulative incidence of selected smoking-related diseases, by sex and age when daily smoking began, household population aged 35 to 64, Canada, 2000/01



Data source: *2000/01 Canadian Community Health Survey, Cycle 1.1*

Heart disease

The cumulative incidence of heart disease began to diverge, depending on smoking history, at around age 40. By age 60, 16% of male and 12% of female adolescent starters had been diagnosed with heart disease. The corresponding figures for young adult starters were 11% and 9%, and for never-smokers, 5% for both sexes.

Although women's cumulative incidence of heart disease was lower than men's, the increase from age 55 to 60 among adolescent starters was much sharper among women. Between these ages, the proportion of female adolescent starters with heart disease doubled from 6% to 12%; over the same period of their lives, the increase for male adolescent starters was from 9% to about 16%.

Rheumatoid arthritis

The link between cigarette smoking and rheumatoid arthritis is less well-established than that with COPD or heart disease.[18-25] It has been suggested that "cigarette smoking may have direct biological effects on rheumatoid arthritis by increasing serum rheumatoid factor and altering immune function in the lung."[18,26-28]

Results of the 2000/01 CCHS show that by age 35 for men and by age 40 for women, the cumulative incidence of rheumatoid arthritis among smokers exceeded that of never-smokers. By age 60, among men, 10% of adolescent starters and 8% of young adult starters had rheumatoid arthritis, compared with 5% of never-smokers. For women, the cumulative incidence of the disease for the two groups of smokers converged around age 45, and by age 60, it had reached 11%, compared with 8% for never-smokers.

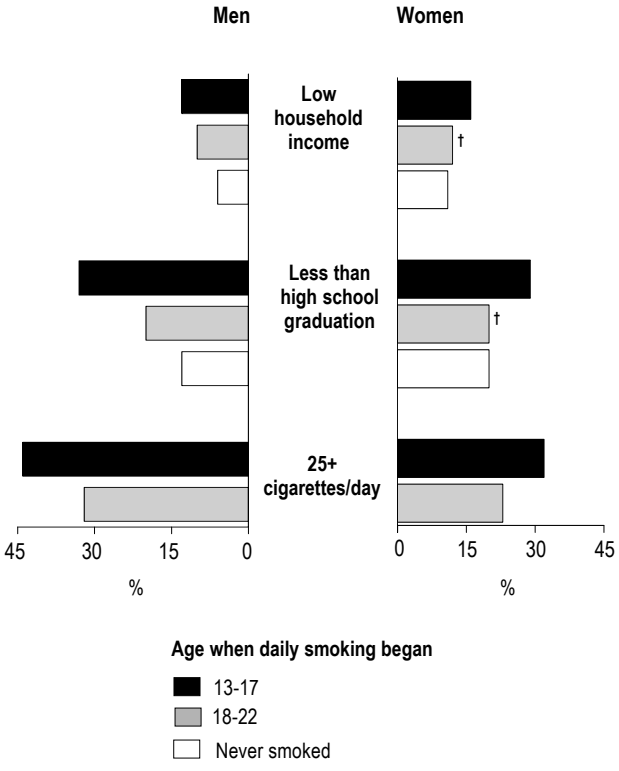
At least one

Not surprisingly, the cumulative incidence of having at least one of the three diseases was highest among smokers who had started smoking daily in adolescence. By age 60, 32% of male adolescent starters had been diagnosed with COPD and/or heart disease and/or rheumatoid arthritis; corresponding figures were 24% for young adult starters, and 14% for never-smokers. Among women, the percentages were even higher: 41%, 29% and 17%, respectively.

Relationships hold when other factors considered

Smoking-related diseases are often deeply rooted in the socio-economic environment.[29] Therefore, the age at which an individual becomes a daily smoker is unlikely to be the only factor contributing to the eventual development of a chronic disease. According to the results of the CCHS, smokers, especially those who began smoking daily in adolescence, tended to have less formal education than did never-smokers and were more likely to live in low-income households (Chart 3). As well, cigarette consumption tended to be higher among

Chart 3
Prevalence of low household income, low education and heavy smoking, by sex and age when daily smoking began, household population aged 35 to 64, Canada, 2000/01



Data source: *2000/01 Canadian Community Health Survey, Cycle 1.1*
† All differences between groups are statistically significant ($p < 0.05$) except for this group compared with "Never smoked." Significance tests were adjusted for multiple comparisons.

Definitions

Respondents to the Canadian Community Health Survey (CCHS) were asked about chronic conditions that had lasted or were expected to last six months or more and that had been diagnosed by a health professional.

The clinical definition of *chronic obstructive pulmonary disease (COPD)* includes chronic bronchitis characterized by a persistent cough productive of sputum with airflow obstruction, and emphysema accompanied by airflow obstruction. Emphysema is an abnormal permanent enlargement of the tiny air sacs of the lungs (alveoli) and the destruction of their walls.[30] Responses to two CCHS questions were used to determine if respondents had COPD. One question asked if they had "emphysema or chronic obstructive pulmonary disease" and the other, if they had "chronic bronchitis." For this analysis, respondents who replied positively to at least one of these questions were defined as having COPD.

Respondents were considered to have *heart disease* if they answered "yes" to the question: "Do you have heart disease?"

Respondents were asked: "Do you have arthritis or rheumatism, excluding fibromyalgia?" Those who replied affirmatively were asked: "What kind of arthritis do you have?" The choices were rheumatoid arthritis, osteoarthritis, and other. This analysis concerns only those who reported *rheumatoid arthritis.*

To determine *age at diagnosis,* respondents who replied "yes" to a condition were asked: "How old (age in years) were you when this was first diagnosed?"

Respondents were asked if they had smoked 100 or more cigarettes (about 4 packs) in their lifetime. They were also asked: "At the present time, do you smoke cigarettes daily, occasionally, or not at all?" Those who reported smoking daily were asked at what age they began to do so. Respondents who reported that they currently smoked occasionally or not at all were asked: "Have you ever smoked daily?" If they had, they were asked at what age they had begun to smoke daily and when they had stopped (less than one year ago, 1 to 2 years ago, 3 to 5 years ago, or more than 5 years ago). Smokers selected for this analysis were those who had started smoking daily at ages 13 to 22 and had smoked at least 100 cigarettes in their lifetime for at least 7 years. Never-smokers were those who reported that they had not smoked at all.

Age when daily smoking began was classified as adolescence (13 to 17) or young adulthood (18 to 22).

Current daily smokers were asked: "How many cigarettes do you smoke each day now?" *Number of cigarettes smoked per day* was classified as 25 or more or less than 25. Because no information was available about lifetime cigarette consumption, the number of cigarettes smoked per day as reported to the CCHS was used as a proxy for the amount smoked before the onset of disease.

Three levels of *education* were established: less than high school graduation; high school graduation or some postsecondary; and postsecondary graduation. Since most postsecondary graduates obtain their first qualification (diploma, certificate, or bachelor's degree) in their early twenties, it is assumed that the highest education level used for this analysis had been attained by age 25.

Current *household income* was based on total annual income and number of household members:

Household income group	People in household	Total household income
Low	1 to 4	Less than $10,000
	5 or more	Less than $15,000
Lower-middle	1 or 2	$10,000 to $14,999
	3 or 4	$10,000 to $19,999
	5 or more	$15,000 to $29,999
Upper-middle/High	1 to 4	$15,000 or more
	3 or 4	$20,000 or more
	5 or more	$30,000 or more

adolescent starters than young adult starters. Consequently, in assessing the temporal relationship between smoking and the incidence of disease, it is necessary to take income, education and daily cigarette consumption into account. In this analysis, household income and educational attainment as reported in 2000/01 were used as a proxy for those factors during the years when daily smoking began (see *Limitations*). The number of cigarettes smoked per day in 2000/01 was used as a proxy for cigarette consumption before the diagnosis of a smoking-related disease.

Even when household income, education and number of cigarettes smoked per day were taken into account, the risk of developing COPD among adolescent starters was three times that of never-smokers; for young adult starters, the risk was about twice as high (Table 1). Moreover, among women,

Table 1
Hazards ratios for diagnosis of selected smoking-related diseases, by sex and age when daily smoking began, household population aged 35 to 64, Canada, 2000/01

Age when daily smoking began	Chronic obstructive pulmonary disease		Heart disease		Rheumatoid arthritis		Any of three selected diseases	
	Hazards ratio	95% confidence interval	Hazards ratio	95% confidence interval	Hazards ratio	95% confidence interval	Hazards ratio	95% confidence interval
Model 1 (unadjusted)								
Men								
13-17	4.22‡§	2.45, 7.27	2.84‡§	2.12, 3.81	2.22‡§	1.70, 2.88	2.65‡§	2.23, 3.15
18-22	2.51‡	1.34, 4.71	1.90‡	1.33, 2.72	1.58‡	1.11, 2.26	1.82‡	1.47, 2.26
Never smoked†	1.00	...	1.00	...	1.00	...	1.00	...
Women								
13-17	4.30‡§	3.19, 5.79	2.12‡§	1.55, 2.89	1.54‡	1.26, 1.89	2.59‡§	2.27, 2.95
18-22	2.60‡	1.87, 3.62	1.40	0.99, 1.99	1.46‡	1.16, 1.84	1.75‡	1.50, 2.04
Never smoked†	1.00	...	1.00	...	1.00	...	1.00	...
Model 2 (adjusted for household income and education)								
Men								
13-17	3.66‡	2.09, 6.40	2.71‡§	2.02, 3.64	2.04‡	1.54, 2.70	2.50‡§	2.09, 3.00
18-22	2.43‡	1.26, 4.69	1.82‡	1.26, 2.63	1.53‡	1.06, 2.22	1.76‡	1.41, 2.20
Never smoked†	1.00	...	1.00	...	1.00	...	1.00	...
Women								
13-17	3.60‡§	2.66, 4.86	1.84‡§	1.35, 2.51	1.47‡	1.19, 1.81	2.38‡§	2.08, 2.72
18-22	2.56‡	1.84, 3.57	1.31	0.92, 1.86	1.41‡	1.11, 1.78	1.71‡	1.47, 2.00
Never smoked†	1.00	...	1.00	...	1.00	...	1.00	...
Model 3 (adjusted for household income, education and number of cigarettes smoked per day)								
Men								
13-17	3.00‡	1.58, 5.67	2.50‡§	1.82, 3.43	2.03‡	1.49, 2.76	2.35‡§	1.92, 2.87
18-22	2.09‡	1.01, 4.34	1.71‡	1.15, 2.55	1.52‡	1.03, 2.26	1.68‡	1.32, 2.13
Never smoked†	1.00	...	1.00	...	1.00	...	1.00	...
Women								
13-17	3.00‡§	2.15, 4.17	1.73‡	1.22, 2.47	1.64‡	1.28, 2.11	2.33‡§	2.00, 2.70
18-22	2.23‡	1.55, 3.19	1.26	0.87, 1.82	1.53‡	1.19, 1.95	1.69‡	1.43, 1.99
Never smoked†	1.00	...	1.00	...	1.00	...	1.00	...

Data source: *2000/01 Canadian Community Health Survey, Cycle 1.1*
† Reference group
‡ Significantly different from "Never smoked" ($p < 0.05$)
§ Significantly different from those who began daily smoking at ages 18 to 22 ($p < 0.05$)
··· Not applicable

the risk of being diagnosed with COPD was significantly higher for adolescent starters than for young adult starters.

The relationship between early smoking initiation and heart disease was similar. Adolescent starters had about twice the risk of having been diagnosed with heart disease, compared with never-smokers. And among men, but not women, the risk compared with never-smokers was also significantly high for young adult starters. In addition, for men the risk of heart disease was significantly higher among adolescent starters than for young adult starters.

Smokers had a significantly higher risk of rheumatoid arthritis, compared with those who had never smoked. However, the risk was not significantly higher for adolescent starters than for young adult starters.

Not unexpectedly, given the results for the diseases individually, the risk of having been diagnosed with at least one of them was significantly

greater for smokers than for people who had never smoked, and it was also greater for adolescent starters than for young adult starters.

Concluding remarks

The results of this analysis of data from the 2000/01 Canadian Community Health Survey show that people who began daily smoking in adolescence and

Limitations

Data from the Canadian Community Health Survey (CCHS) on the presence of chronic conditions are self-reported. No independent source verified if people who reported having been diagnosed with chronic bronchitis, emphysema/chronic obstructive pulmonary disease, heart disease or rheumatoid arthritis actually did have those diseases. As well, these broad terms do not specify the nature of a condition or its severity. For instance, cigarette smoking is a major risk factor for coronary heart disease,[31] but the CCHS question refers to "heart disease," which includes non-coronary heart diseases, whose relationship with smoking is unknown. Therefore, the detrimental effects of smoking on heart health may have been underestimated in this analysis. On the other hand, the prevalence of rheumatoid arthritis may be overestimated. The proportion of people affected, based on CCHS data, is high compared with other sources.[32,33] To some degree, this may be attributable to respondents' lack of awareness of the distinction between rheumatoid and osteoarthritis.

The central question—"How old were you when the condition was first diagnosed?"—is subject to recall error. Age at diagnosis could also vary by individuals' awareness of illness, the point at which they were willing to seek doctors' care, and the accuracy of diagnoses. The age at which daily smoking began is also subject to recall error, and furthermore, may be affected by a reluctance to acknowledge socially undesirable behaviour, although self-reported data on smoking are considered to be relatively valid.[34]

As well, age at diagnosis of a disease may be affected by access to medical services. An earlier study has shown that a relatively high proportion of people in low-income households report unmet health care needs stemming from accessibility problems (cost or transportation).[35] Since a comparatively large percentage of smokers, especially those who became daily smokers in adolescence, lived in low-income households, they may tend to be diagnosed late or not at all. Consequently, the effects of smoking on the incidence of COPD, heart disease and rheumatoid arthritis may have been underestimated.

Restricting the analysis to people who were free of the three diseases at age 25 may have excluded the most susceptible, especially among early smokers. For example, 220 respondents who became daily smokers in adolescence and 106 who began as young adults reported that they had been diagnosed with COPD when they were younger than 25; this compared with 61 never-smokers. The weighted percentages of those who had COPD at age 25 or earlier were 2.0%, 1.3% and 0.3%, respectively. The proportions for heart disease were 0.5% (n=61), 0.5% (n=23) and 0.2% (n=37), and for rheumatoid arthritis, 1.2% (n=125), 0.8% (n=64) and 0.4% (n=84). As a result, the association between early smoking initiation and the incidence of those diseases may be underestimated.

Even though the analysis excludes seniors, the possibility of attrition-related bias remains, because the people most susceptible to the three diseases may have died or moved to a health-related institution.

Some measurement error may exist because people in poor health are simply more inclined to report themselves as having several different illnesses. However, co-morbidity for the three diseases was relatively low. For example, the prevalence of at least one of the three was 13.6% for adolescent starters, 11.4% for young adult starters, and 7.3% for never-smokers, but the corresponding prevalence of co-morbidity (having two or more of the three diseases) was just 1.5%, 1.1%, and 0.7%.

The etiology of smoking-related illness is multifactorial, involving both genetic and environmental elements.[4,28,36] However, this analysis includes relatively few control variables because of the potential for measurement errors related to their time-dependent nature. Notably, education, household income and number of cigarettes smoked per day pertain to the time of the CCHS interview, but are used as proxies for education, income and smoking before the onset of smoking-related disease. A respondent's situation might have changed, so the effects of these control variables are not highlighted.

The ages of respondents included in the analysis spanned 30 years (ages 35 to 64). During the last three decades, the prevalence of smoking has declined. In addition, the risk of COPD, heart disease and rheumatoid arthritis increases with age. Consequently, it is possible that non-smokers may be younger and at lower risk of being diagnosed with these diseases. Nonetheless, even with a breakdown of the sample into two sex-specific age groups (35 to 49 and 50 to 64), the patterns of estimated incidence of the three diseases by age of onset of daily smoking persisted (data not shown).

young adulthood were at increased risk of developing COPD, heart disease and rheumatoid arthritis, even when current educational attainment, household income and cigarette consumption were taken into account. From a population health standpoint, the implications are substantial. Prevention of smoking, especially in adolescence, may substantially delay the onset of these disabling or fatal diseases.

The link between early smoking and COPD independent of a duration of smoking effect is particularly striking. Smoking in adolescence may impede the normal development of lung function.[37-39]

As well, although women are less likely to smoke heavily, their risk of being diagnosed with COPD was higher than that of men. Thus, the CCHS data support some recent studies suggesting that women may be more vulnerable to the detrimental effects of smoking.[4,6,8,9] Biological differences in terms of lung size may increase women's sensitivity and put them at greater risk.[6,8,9,29,40,41]

The link between early smoking initiation and an early onset of coronary heart disease has been attributed to cumulative exposure.[3] It has also been suggested that the effects of smoking on lipid levels in adolescence may contribute to the development of atherosclerosis in young adulthood.[36]

While the relationship between the age of smoking initiation and rheumatoid arthritis in this analysis is modest, it is not negligible. The disease imposes a tremendous societal and individual burden.[42] If the link between smoking and rheumatoid arthritis is causal and the condition can be added to the list of smoking-related diseases, reducing the prevalence of smoking among adolescents and young adults[30] could be expected to yield even greater public health benefits than are estimated in current smoking prevention initiatives. ●

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Appendix

Table A
Distribution of selected characteristics, household population aged 35 to 64, Canada, 2000/01

	Both sexes			Men			Women		
		Estimated population			Estimated population			Estimated population	
	Sample size	'000	%	Sample size	'000	%	Sample size	'000	%
Total	**34,144**	**7,025**	**100.0**	**15,517**	**3,297**	**100.0**	**18,627**	**3,728**	**100.0**
Age when daily smoking began									
13-17	10,999	1,977	28.1	5,983	1,108	33.6	5,016	868	23.3
18-22	7,086	1,318	18.8	3,341	660	20.0	3,745	658	17.7
Never smoked	16,059	3,731	53.1	6,193	1,529	46.4	9,866	2,202	59.1
Education									
Less than high school graduation	8,106	1,487	21.2	3,825	682	20.7	4,281	805	21.6
High school graduation/Some postsecondary	9,152	1,937	27.6	3,814	819	24.9	5,338	1,117	30.0
Postsecondary graduation	16,525	3,529	50.2	7,706	1,760	53.4	8,819	1,769	47.5
Missing	361	72	1.0	172	36	1.1	189	35	1.0
Household income									
Lowest	4,302	699	10.0	1,649	282	8.5	2,653	418	11.2
Lower-middle	6,623	1,278	18.2	2,664	537	16.3	3,959	741	19.9
Upper-middle/High	20,053	4,413	62.8	9,929	2,210	67.0	10,124	2,204	59.1
Missing	3,166	634	9.0	1,275	269	8.2	1,891	365	9.8
Cigarettes per day									
25+	6,418	1,117	15.9	3,912	692	21.0	2,506	425	11.4
Less than 25	27,663	5,899	84.0	11,569	2,600	78.9	16,094	3,299	88.5
Missing	63	9[E1]	0.1[E1]	36	5[E1]	0.2[E1]	27	4[E2]	0.1[E2]

Data source: *2000/01 Canadian Community Health Survey, Cycle 1.1*
Note: *Because of rounding, detail may not add to totals.*
E1 Coefficient of variation between 16.6% and 25.0%
E2 Coefficient of variation between 25.1% and 33.3%


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Neighbourhood low income, income inequality and health in Toronto

Feng Hou and Jiajian Chen

Abstract

Objectives

This study examines the association of neighbourhood low income and income inequality with individual health outcomes in Toronto, Canada's largest census metropolitan area.

Data sources

The data are from the cross-sectional component of Statistics Canada's 1996/97 National Population Health Survey (NPHS) and the 1996 Census of Population.

Analytical techniques

Individual records for Toronto residents aged 12 or older who responded to the 1996/97 NPHS were augmented with aggregated data from the 1996 Census to provide information on the average socio-economic characteristics of the respondents' neighbourhoods. Hierarchical linear models were used to estimate the effect of low income and income inequality at the neighbourhood level on selected health outcomes.

Main results

When individual low-income status and several other individual characteristics were taken into account, the neighbourhood low-income rate and income inequality were not associated with individuals' reported number of chronic conditions or distress. However, both low income and income inequality at the neighbourhood level remained significantly associated with poor self-perceived health.

Key words

poverty, low-income population, health status indicators

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A growing body of research in the United States and Europe has indicated that living in a low-income neighbourhood has a negative effect on an individual's health-related behaviours and health status.[1-13] Low-income neighbourhoods often have relatively few community resources, such as schools, recreational facilities, churches, public transportation, law enforcement, sanitation, and health and family services,[2,6,7] and unhealthy physical environments—pollution, crowding and inferior housing.[14] Stressful social conditions, including social isolation and high crime rates, may also exist in low-income neighbourhoods.[15-19] And, because people may conform to prevailing norms, low-income neighbourhoods are likely to have a high prevalence of unhealthy behaviours—smoking, heavy drinking and lack of physical activity—as well as passive attitudes toward health and health care.[2,20,21]

In addition to neighbourhood poverty, income inequality within neighbourhoods, which is an indicator of relative deprivation, has been viewed as a potential determinant of individual health.[22] Many ecological studies have found statistical associations between income inequality and

average health status at the population level, both between countries and between large areas within a country.[23-26] Income inequality may weaken social cohesion and have a detrimental psychological effect on individual health.[23,27,28]

Few studies have examined the association between income inequality and individual health at the local level.[29] The health effects of inequality are more apparent in large societies than in small geographic areas, where it is more difficult to compare social strata.[27] Theoretically, income inequality at the local level could have a positive effect on individual health. Income inequality within neighbourhoods reflects economic integration, low social isolation, and a high likelihood of sharing communal resources.[13] On the negative side, wide economic disparities among residents of a small area may heighten social comparisons, provoke distrust, and create a sense of injustice and dissatisfaction among the disadvantaged.[16,31]

Most of Canada's major metropolitan areas have experienced neighbourhood concentration of low-income and growing income inequality in the last two decades.[32-34] Although some Canadian studies have examined the connection between socio-economic conditions and variations in population health at the neighbourhood level, they have not separated health differences due to neighbourhood socio-economic conditions from those due to individual characteristics.[35,36] Thus, such studies may have overestimated the effect of neighbourhood socio-economic conditions on health. For instance, a significant association between neighbourhood low income and poor health status could be because low-income neighbourhoods tend to have more low-income people, and people with lower incomes tend

Data sources

This analysis is based on cross-sectional household data from the 1996/97 National Population Health Survey (NPHS) and the 1996 Census tract profiles for the Toronto census metropolitan area (CMA).[30] Every two years, the National Population Health Survey (NPHS), which began in 1994/95, collects information about the health of Canadians. It covers household and institutional residents in all provinces and territories, except persons on Indian reserves, on Canadian Forces bases, and in some remote areas. The NPHS has both longitudinal and cross-sectional components.

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 the random digit dialing (RDD) technique.

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.

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, the person providing in-depth health information about himself or herself 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 cycle 2, 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.

In 1996/97, there were 81,804 respondents to the questions on the Health file. The 1996/97 cross-sectional response rates for the Health file were 93.1% for the longitudinal component and 75.8% for the RDD component, yielding an overall response rate of 79.0%. More detail on the NPHS is available in published reports.[37,38]

to have poor health. On the other hand, neighbourhood low income may create an unhealthy environment for all residents regardless of their personal income. A combination of both effects is also possible.

A neighbourhood's potential influences on health are often called "contextual effects." These are "the aggregate effect of social, cultural and environmental characteristics of the neighbourhood, that is, similar types of individuals will have different

Analytical techniques

Census summary statistics about neighbourhood socio-economic conditions were matched to the records of each NPHS respondent, using Health PCCF+, a SAS program for automated geographic coding based on the Postal Code Conversion Files prepared by Statistics Canada.[39]

In this analysis, the census tract represents the basic neighbourhood unit. Census tracts are permanent small geo-statistical areas in large urban communities that are carefully established to be as similar as possible in terms of economic status and social conditions.[40] In 1996, Toronto had 808 census tracts. Four were deleted from this analysis because most of their census information was suppressed due to small population size. Another four with small populations (less than 500 people) were excluded to ensure the reliability of derived neighbourhood characteristics. Two more tracts were deleted because they contained no NPHS respondents. In the remaining 798 tracts, the total estimated population ranged from 554 to 25,437, with a mean of 5,333 (standard deviation: 2,372).

There were 9,002 NPHS respondents aged 12 or older residing in Toronto in 1996/97. Records for 121 individuals whose reported postal codes did not match any of the census tract codes were excluded. Another 19 respondents belonging to census tracts for which information was suppressed in the census profile or to tracts that had small populations were also excluded. Therefore, this analysis is based on 8,862 Toronto residents, weighted to represent an estimated 3.6 million Canadians. Compared with the selected weighted sample of these residents, the excluded weighted cases had a higher percentage of women than men (63% versus 51%) and reported poorer self-perceived health. However, there were no statistical differences between these two groups when weighted estimates for age, education, household income, level of distress, and number of chronic conditions were compared.

Using HLM5 (hierarchical linear models),[41,42] two models were fitted to the data in three stages (see Appendix Tables A, B, and C for complete models).

First, a random-effect one-way ANOVA (Model 1) was fitted to determine the total amount of variability in the health outcomes (number of chronic conditions, distress, and self-perceived health) within and between neighbourhoods. Next, a means-as-outcome model (Model 2) was used to regress the neighbourhood average of an individual health outcome on the neighbourhood low-income rate and income inequality at the neighbourhood level to examine the extent to which the between-neighbourhood variation in each of the selected health outcomes was associated with the extent of neighbourhood low income and income inequality. At this stage, individual characteristics were not considered.

Second, a one-way ANCOVA with random effects (Model 1) was used to estimate average health status of each neighbourhood, adjusting for individual low-income status. Then, a means-as-outcome regression (Model 2) was used to estimate the association between the neighbourhood average of the health outcome and the low-income rate and income inequality, adjusting for individuals' low-income status. The results indicate if neighbourhood low income and income inequality have an effect on individual health over and above the effect of low income at the individual level.

The third and final stage controlled for low-income status at the individual level, as well as age, sex, education, alcohol dependence, smoking, physical inactivity, and perceived emotional support (see *Definitions*). The analysis tested whether the effect of the extent of neighbourhood low income and income inequality on individual health remained statistically significant when the effects of the individual characteristics were taken into account.

In Models 1 and 2, at each step, the chi-square statistic indicates whether the neighbourhood component explains a significant amount of the variance in each selected outcome. If the variance is not significantly greater than zero, it would suggest that all neighbourhoods have the same average score on the selected health outcome. In Model 2, a significant coefficient indicates whether neighbourhood average scores of the selected health outcome estimated in Model 1 are associated with neighbourhood low-income level and income inequality.

The original NPHS sampling design relied on household selection through a multi-stage stratified cluster probability sampling procedure. Population weights were given to each respondent record to produce estimates representative of the Canadian population in 1996/97. In the individual-level analyses, population weights were rescaled to an average weight of 1 so the sum of the rescaled weights equalled the sample size. The rescaled weights were used to avoid underestimating standard errors, while maintaining the same distribution as those obtained when using the population weight.

Definitions

Three *health outcomes* were examined in this analysis: number of chronic conditions, distress, and self-perceived health.

National Population Health Survey (NPHS) respondents were asked if they had "any long-term health conditions that have lasted, or are expected to last, six months or more and that have been diagnosed by a health professional." A checklist of 22 conditions was read to them: food allergies, other allergies, asthma, arthritis or rheumatism, back problems (excluding arthritis), high blood pressure, migraine, chronic bronchitis or emphysema, sinusitis, diabetes, epilepsy, heart disease, cancer, stomach or intestinal ulcers, effects of a stroke, urinary incontinence, bowel disorder such as Crohn's disease or colitis, Alzheimer's disease or other dementia, cataracts, glaucoma, thyroid condition, and any other long-term condition that has been diagnosed by a health professional. The number of chronic conditions diagnosed within the last 12 months could range from 0 to a maximum of 13.

Distress level was derived from a subset of items from the Composite International Diagnostic Interview.[30] It was based on responses to six questions: "During the past month, about how often did you feel—so sad that nothing could cheer you up?; nervous? restless or fidgety? hopeless? worthless? that everything was an effort?" Each question was answered on a five-point scale, ranging from "none of the time" (score 0) to "all of the time" (score 4). Responses to all items were scored and summed; the possible range is 0 to 24, with high positive scores indicating greater distress (Cronbach's alpha = 0.79).

Self-perceived health refers to an individual's global assessment of his or her health. Respondents were asked: "In general, would you say your health is excellent, very good, good, fair or poor?" Scores range from 1 to 5, with a higher score indicating poorer self-perceived health.

Although all three health outcomes were treated as continuous variables in this analysis, alternative analyses that treated chronic conditions and self-perceived health as categorical variables were also conducted (data not shown). Self-perceived health was coded as a dichotomous variable: poor (fair or poor) versus other (excellent, very good, good). Two ways of creating a dichotomous variable for chronic conditions were explored: one compared individuals with or without any chronic conditions; the other contrasted those with at least two chronic conditions versus "other" (one condition or none). These alternate analyses yielded the same significant associations between outcome and neighbourhood explanatory variables as the analyses that treated the outcome variables as continuous. Results of the models using continuous variables are presented in this article because this allowed the use of ANOVA and ANCOVA to decompose the variance in the dependent variables into between- and within-neighbourhood components (see *Analytical techniques).*

Two neighbourhood-level income variables were included in the analysis: neighbourhood low income and income inequality. *Neighbourhood low income* is defined as the proportion of the population in each census tract with an economic family income below Statistics Canada's low-income cut-offs (LICOs). An economic family is a group of two or more people who live in the same dwelling and who are related by blood, marriage, a common-law relationship, or adoption. LICOs take into account income and expenditure patterns in seven family-size categories and in five community-size groups. Compared with the average household, a family at or below the LICO spends 20 percentage points more of its income on food, clothing and shelter. In 1996 in Toronto, a family of four with a before-tax income below $32,328 would be classified as low income.[43] The neighbourhood low-income rate ranged from 2.1% to 76.5%.

Since the low-income rate is clustered toward the low end of the distribution (Appendix Table D) and the effect of neighbourhood economic condition on individuals' health may be nonlinear,[20,44,45] the *neighbourhood low-income rate* was used as a categorical variable: lowest (2.1% to 9.9%), lower-middle (10.0% to 19.9%), upper-middle (20.0% to 39.8%) and highest (40.0% to 76.5%). Census tracts with a low-income rate of at least 40% are usually identified as high-poverty neighbourhoods.[46,47]

Neighbourhood income inequality was measured by the coefficient of variation (CV), based on economic family income from the 1996 Census. To calculate the CV, economic family incomes were adjusted for the economies of scale associated with family size.[48] The CVs ranged from 0.44 (the standard deviation is less than one half of the mean) to 3.69 (the standard deviation is 3.69 times larger than the mean), but were clustered toward the low end of the distribution. In multivariate analyses, CVs were grouped into four quartiles: least inequality (0.44 to 0.61), lower-middle inequality (0.61 to 0.70), upper-middle inequality (0.70 to 0.84), and greatest inequality (0.84 to 3.69). (Appendix Table D). The ratio between the 90th and 10th percentiles of the family income distribution was also used as an alternative measure of neighbourhood income inequality. This ratio for the Toronto CMA is 7.2 (that is, the top 10% of families have income about 7.2 times higher than the bottom 10% of families). Among the census tracts for the Toronto CMA, such ratios ranged from 2.8 to 48.0. This ratio was above the CMA average (7.2) in about 31% of the census tracts, and over 10 in about 12% of the tracts. The two measures of income inequality produced similar results in multivariate analysis. Results were presented using the coefficient of variation only because it was not significantly correlated with the neighbourhood low-income rate, while the ratio of 90th over 10th percentile was correlated.

Individual low-income status was measured using a two-category measure of income adequacy that considers household income and household size.[30] Respondents with an annual income of less than $15,000 and a household size of 1 to 2 people, or less than $20,000 and a household size of 3 or 4, or less than $30,000 and a household size of 5 or more were coded as 1, or "yes," low income. Others with information on income were coded as 0, or "no," and constituted the reference group. About 8.7% of respondents had low-income status, and about 61.5% did not (Appendix Table D). Since a large percentage (29.8%) of respondents did not report their income, another dichotomous variable (income missing = 1, others = 0) was created to incorporate them into the analyses.

Several other variables were included for analysis at the individual level: sex, age, education, smoking, alcohol dependence, physical inactivity and perceived emotional support. These variables were used primarily to further control for compositional differences in population characteristics among neighbourhoods that are likely related to both individual low income and health outcomes.

Age, a continuous variable coded by single year, ranged from 12 to 99. *Sex,* a dichotomous variable, was coded as female = 1, male = 0. *Education* was coded as less than high school graduation = 0 or high school graduation or more = 1.

Two categories were coded for *smoking*: daily smoker = 1, no = 0.

The NPHS uses the full range of nine questions developed by Kessler et al.,[49] based on a subset of items from the Composite International Diagnostic Interview, to derive the measure of *alcohol dependence*. The questions use Criterion A and Criterion B of the DSM-III-R diagnosis of "psychoactive substance use disorder," and they were asked only of respondents who reported that they had consumed five or more drinks on one occasion, at least once a month, during the past 12 months. For those who were not asked these questions, the score was coded as zero. Scores range from 0 to 7, with a higher score indicating a stronger risk of alcohol dependence.

Physical activity was coded as active = 1, moderate = 2, and inactive = 3.

The *perceived emotional support* scale consists of four items that reflect whether respondents feel they have someone they can confide in, count on, who can give them advice, and who makes them feel loved. Scores range from 0 to 4, with a high score indicating a high degree of perceived emotional support.[30]

…health status in different types of neighborhoods."[5] By comparison, "compositional effects" are "the aggregate of all individual characteristics in a neighborhood, that is, similar types of persons will have similar illness experiences no matter where they live."[5]

The 1996/97 National Population Health Survey (NPHS) offers a large sample, as well as a variety of health measures and socio-economic attributes of individuals. Augmenting the individual NPHS records with aggregated data from the 1996 Census of Population provides reliable information on the average socio-economic characteristics of the individuals' immediate neighbourhoods. This article uses multi-level modelling to examine the association of neighbourhood low income and income inequality with three individual health outcomes—number of chronic conditions, level of distress, and self-perceived health—in Toronto, Ontario (see *Data sources, Analytical techniques, Definitions* and *Limitations*).

Although a few Canadian studies have investigated the contextual effects of geographic areas using multi-level modelling,[50-52] none has focussed on the contextual effect of neighbourhood low income and income inequality at the census tract level within a major metropolitan area.

The Toronto CMA

Toronto is Canada's largest census metropolitan area (CMA), and it has the highest level of neighbourhood income inequality among CMAs.[33] Therefore, if neighbourhood low income and income inequality have detrimental effects on individual health status, such effects are likely to be apparent in Toronto.

In 1996, Toronto contained about 15% of Canada's total population. Neighbourhood (census tract) low-income rates differed drastically. In the CMA's most affluent neighbourhood, only 1 person out of 50 was in a low-income family in 1995 (the year for which income was reported). By contrast, in the neighbourhood with the highest low-income rate, 8 out of 10 people lived in low-income families.

There were also large income disparities in many neighbourhoods. In about 12% of Toronto's census tracts, the highest income families (the top 10%) had incomes more than 10 times higher than the lowest income families (the bottom 10%).

Chronic conditions

No consistent pattern emerged between low income and income inequality at the neighbourhood level in Toronto and the average number of chronic conditions reported by individuals (Table 1, Appendix Table A). Neighbourhoods with the highest income inequality had higher average numbers of chronic conditions than neighbourhoods with the lowest income inequality, even after controlling for individual low-income status. But this relationship was no longer present when individuals' age was included in the model, because neighbourhoods with the lowest income inequality had the youngest population, and being younger was associated with fewer chronic problems. Individual low-income status, however, was associated with having more chronic conditions.

Several other individual characteristics were significantly related to the number of chronic conditions. People with at least high school graduation had fewer chronic conditions than those with less education. Women had more chronic health problems than did men, and older people had more chronic conditions than did younger ones. Alcohol dependence was associated with an increased number of chronic conditions, as was daily smoking. People with relatively strong emotional support tended to have fewer chronic conditions.

Level of distress

Level of distress was assessed by asking people about their feelings in the past month (see *Definitions*), including how often they felt so sad nothing could cheer them up, and how often they felt nervous, hopeless or worthless.

The average level of distress tended to be higher in low-income neighbourhoods (those with the highest low-income rates), compared with neighbourhoods where low-income rates were lowest (Table 1, Appendix Table B). When individual low income was taken into account, however, the difference was no longer statistically significant. Additional adjustments to consider other

individual characteristics reduced the difference even further, indicating that the association between the extent of neighbourhood low income and individuals' reported levels of distress is likely attributable to a compositional effect.

Neighbourhoods with the widest income inequality tended to have a lower average level of distress than did neighbourhoods with the least income inequality, even after controlling for individual low-income status. This association, however, did not remain statistically significant when individuals' age was included in the model, because neighbourhoods with the greatest income inequality had the oldest populations, and older age was associated with lower levels of distress.

Low-income is a significant predictor of an individual's distress level, and people with low-income status are more likely to live in low-income neighbourhoods. Being younger, a female, having less than high school graduation, a stronger dependence on alcohol, daily smoking and lower emotional support were all associated with higher levels of distress.

Neighbourhood low income, income inequality associated with poor self-perceived health

NPHS respondents were asked to rate their own health as excellent, very good, good, fair, or poor, with scores ranging from 1 to 5, respectively, and higher scores indicating poorer health (see *Definitions*). Average scores for self-perceived health differed significantly from one Toronto neighbourhood to another (Table 1, Appendix Table C). Further, the neighbourhood variation in average self-perceived health was associated with the neighbourhood low-income rate and the highest level of income inequality. Low-income

Table 1
Average number/scores on selected health outcomes, by neighbourhood low-income rate, adjusted for neighbourhood income inequality, Toronto census metropolitan area, 1996/97

	Adjusted for neighbourhood income inequality only	Adjusted for neighbourhood income inequality and: Individual low-income status	Adjusted for neighbourhood income inequality and: Individual low-income status, age, sex, education, alcohol dependence, smoking, physical inactivity, support
Average number of chronic conditions†			
Neighbourhood low-income rate			
Lowest (2.1%-9.9%)	1.04	1.07	1.14
Lower-middle (10.0%-19.9%)	1.03	1.04	1.14
Upper-middle (20.0%-39.8%)	1.03	1.02	1.11
Highest (40.0%-76.5%)	1.02	0.98	1.14
Average distress level‡			
Neighbourhood low-income rate			
Lowest (2.1%-9.9%)	2.21	2.28	2.28
Lower-middle (10.0%-19.9%)	2.38	2.43	2.41
Upper-middle (20.0%-39.8%)	2.46*	2.45	2.36
Highest (40.0%-76.5%)	2.61*	2.50	2.29
Average self-perceived health§			
Neighbourhood low-income rate			
Lowest (2.1%-9.9%)	2.11	2.13	2.16
Lower-middle (10.0%-19.9%)	2.20**	2.21*	2.24 **
Upper-middle (20.0%-39.8%)	2.30***	2.29***	2.30 ***
Highest (40.0%-76.5%)	2.38***	2.35***	2.38 ***

Data sources: *1996/97 National Population Health Survey, cross-sectional sample, Health file; 1996 Census of Population*
Note: *For complete models, see Appendix Tables A, B, and C.*
** $p \leq 0.05$; significantly different from neighbourhoods with lowest low-income rates*
*** $p \leq 0.01$; significantly different from neighbourhoods with lowest low-income rates*
**** $p \leq 0.001$; significantly different from neighbourhoods with lowest low-income rates*
† Range 0 to 13
‡ Scale 0 to 24
§ Scale 1 to 5, with higher scores indicating poorer self-perceived health

neighbourhoods tended to have a lower average level of self-perceived health.

Even when controlling for individuals' low-income status, average self-perceived health scores among neighbourhoods remained associated with the neighbourhood low-income rate and income inequality, although the strength of the relationship was attenuated. And when other individual characteristics were taken into account, the association between average self-perceived health and neighbourhood low-income rate and income inequality still remained statistically significant.

The average difference in self-perceived health between people living in neighbourhoods with the highest low-income rates (40.0% to 76.5%) and those in neighbourhoods with the lowest low-income rates (2.1% to 9.9%) is about 0.22, or one-fifth of the standard deviation of the self-perceived health variable (0.99, Appendix Table D), when other factors were held constant. This difference was

Limitations

Although the overall sample used for this analysis is quite large, on average, each census tract had just 11 National Population Health Survey (NPHS) respondents, and half (405) had less than 10. This small sample size at the neighbourhood level should not affect estimates of the effects of individual variables such as sex, age, education, smoking, alcohol dependence or physical inactivity, because hierarchical linear modelling permits reliable estimates of the regression model for a particular tract with a small sample by using a weighted composite of the information from that tract and the relations that exist in the overall sample.[41] However, average neighbourhood health status based on such a small number of observations may be much less reliable and may therefore lead to underestimating the correlation between neighbourhood low income, income inequality and neighbourhood average health status.

To determine if the limited sample size biases the estimate of the effects of neighbourhood low income and income inequality, a larger "neighbourhood" unit was derived by combining census tracts with similar low-income rates. The 798 tracts were grouped into percentiles based on their low-income rates. The tracts were then combined within each percentile into a single aggregated neighbourhood. The aggregated neighbourhoods had an average of 89 NPHS respondents, ranging from 50 to 190. The analyses were repeated for aggregated neighbourhoods rather than census tracts (data not shown). The estimates of the coefficients and standard errors for all individual characteristics remained essentially the same, but the association between neighbourhood low income and neighbourhood average of self-perceived health was much stronger when aggregated neighbourhoods were used.

Based on aggregated neighbourhoods, the neighbourhood low-income rate explained 19.8% of the neighbourhood variation in average self-perceived health scores when all the selected individual variables were taken into account; based on non-aggregated census tracts, the neighbourhood low-income rate explained only 8.3%. This difference suggests that small sample size at the neighbourhood level may lead to an underestimation of the neighbourhood effect.

The associations of neighbourhood economic conditions with chronic conditions and distress were also examined based on aggregated neighbourhoods, but no significant associations were found when the individual characteristics were taken into account.

The data used in this analysis do not contain variables that might explain the mechanisms through which neighbourhood economic conditions affect individual health. Indicators of neighbourhood socialization of unhealthy lifestyles, social networks, communal resources, and physical environment would help researchers understand if the effect of neighbourhood low income and income inequality is independent of or conditioned by other neighbourhood characteristics.

To test whether the health effects of neighbourhood low income and income inequality are affected by another potentially important neighbourhood characteristic, the percentages of recent immigrants (in Canada for 10 years or less) and visible minorities in the neighbourhoods were included in the hierarchical models. The results did not yield different conclusions (data not shown).

The NPHS does not contain information on how long respondents have lived in a specific neighbourhood; therefore, it is not possible to determine if the contextual effect of neighbourhood low income depends on length of exposure. Furthermore, a neighbourhood's socio-economic status may change over time, so even long-term residents may not always be exposed to the same type of environment.

The use of census tracts as "neighbourhoods" may attenuate the true association between neighbourhood socio-economic status and health. Although census tracts have similar population characteristics and economic conditions, they may not coincide with residents' perception of neighbourhoods.[6,7] In fact, many census tracts are not homogeneous in family income. However, because of limited sample size, it was not possible to conduct the analyses using smaller geographic units (enumeration areas, for example).

slightly smaller than the coefficient of individual-level low-income (0.329). Although the magnitude of the difference appears small, it is due to the limited range (1 to 5) in the outcome.

People in neighbourhoods with the greatest income inequality tended to have better average self-perceived health than those in neighbourhoods with the least income inequality even when all the selected individual-level variables were considered.

While low-income status, being older or female, having a stronger dependence on alcohol and being physically inactive were associated with poorer self-perceived health, higher emotional support and having at least high school graduation were associated with better self-perceived health.

Concluding remarks

Whether neighbourhood economic conditions make a difference in individual health status over and above the effect of individual income depends on the health outcome. Self-perceived health was significantly associated with neighbourhood low income and income inequality, even when individual low-income status and other individual characteristics were taken into account. However, the association between the neighbourhood low-income rate and distress was not statistically significant when individual low-income status was considered. And the number of chronic conditions reported was not significantly associated with the neighbourhood low-income rate, even without controlling for individual characteristics. The association of neighbourhood income inequality with distress and number of chronic conditions lost statistical significance when individual age was considered.

It may be that self-perceived health is a more global measure of health status than the other two outcomes. As suggested in previous research, self-perceived health may capture "the full array of illness a person had and possibly even symptoms of disease as yet undiagnosed but present in preclinical or prodromal stages."[53] American and European studies have demonstrated that self-perceived health is an important predictor of the onset of disability and mortality, independent of other medical conditions and psychosocial states.[53,54]

Self-perceived health is also subjective, reflecting individual perceptions of quality of life.[5] By contrast, reports of chronic conditions may be more objective, given that they do not consider the severity of illness. Respondents were asked if the condition(s) had been diagnosed by a health professional. Similarly, distress was measured on a scale using six specific, highly correlated questions.

Further analyses revealed that the interaction between neighbourhood low income and individual-level income was not significant in influencing individuals' self-perceived health (data not shown). This suggests that individuals' low-income status is detrimental to their general health regardless of where they live—in low-income or more affluent neighbourhoods. Thus, low-income people living in low-income neighbourhoods would be subject not only to the effect of individual low income, but also to the contextual effect of neighbourhood low income.

The relatively weak health effects of neighbourhood low income that emerged in this analysis may partly reflect the use of census tracts to represent neighbourhoods. Nonetheless, the findings are consistent with conclusions from previous Canadian studies on the effect of geographic area.[50-52] The results also complement those of a recent Canadian study on the relation between summary indexes of economic segregation and mortality across metropolitan areas.[55]

Other reasons may also partly explain the weak health effect of neighbourhood low income in Toronto. The low-income rate at the census tract level varies with business cycles, so even long-term residents of a certain neighbourhood may not have been exposed to the same economic conditions over time. Also, a large proportion of people in the low-income neighbourhoods were new residents (based on analysis of census mobility data), and had therefore been exposed to the conditions in those neighbourhoods for a short time. The high mobility of residents of these low-income neighbourhoods may have diluted the contextual effect of neighbourhood on individual health.

Although weak, the significant relationship between neighbourhood low income and self-perceived health suggests that the geographic concentration of low-income status and its potential detrimental impact on individual health is not negligible in Toronto. Although this finding cannot be generalized to all Canadian CMAs, it does highlight the need to further monitor and examine the impact of neighbourhood socio-economic context on population health.

This study also found that neighbourhoods with substantial income inequality had better average self-perceived health than neighbourhoods with relatively little income inequality. These results seem to suggest that income inequality at the local level has different social and health implications from income inequality in large societies. Income inequality in large societies is associated with a social environment that undermines individual confidence and trust.[27] By comparison, income inequality at the neighbourhood level may reflect economic heterogeneity and low class segregation.[56]

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Appendix

Table A

Hierarchical linear models for number of diagnosed chronic conditions, Toronto census metropolitan area, 1996/97

Step 1 (unadjusted)	Model 1: One-way ANOVA			Model 2: Means-as-outcome		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standard error**	**t-ratio**
Neighbourhood means						
Intercept	1.096***	0.019	57.8	1.043***	0.044	24.0
Lower-middle low income	...	...	...	-0.016	0.047	-0.3
Upper-middle low income	...	...	...	-0.015	0.050	-0.3
Highest low income	...	...	...	-0.024	0.089	-0.3
Lower-middle income inequality	...	...	...	0.035	0.049	0.7
Upper-middle income inequality	...	...	...	0.107	0.056	1.9
Greatest income inequality	...	...	...	0.122*	0.055	2.2
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.077	796	1141.2***	0.076	790	1131.3***
Individual level	1.958	...	...	1.957	...	...
Step 2 (adjusted for individual low-income status)	**Model 1: One-way ANCOVA**			**Model 2: Means-as-outcome**		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standard error**	**t-ratio**
Neighbourhood means						
Intercept	1.100***	0.019	58.1	1.067***	0.044	24.5
Lower-middle low income	...	...	...	-0.023	0.047	-0.5
Upper-middle low income	...	...	...	-0.044	0.049	-0.9
Highest low income	...	...	...	-0.084	0.088	-1.0
Lower-middle income inequality	...	...	...	0.033	0.049	0.7
Upper-middle income inequality	...	...	...	0.105	0.056	1.9
Greatest income inequality	...	...	...	0.116*	0.055	2.1
Individual characteristics						
Low-income status	0.383***	0.086	4.4	0.385***	0.086	4.5
Income not reported	-0.108**	0.039	-2.8	-0.107**	0.039	-2.7
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.077	796	1141.3***	0.077	790	1132.4***
Individual level	1.943	...	...	1.942	...	...
Step 3 (adjusted for individual low-income status, age, sex, education, alcohol dependence, smoking, physical inactivity, emotional support)	**Model 1: One-way ANCOVA**			**Model 2: Means-as-outcome**		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standard error**	**t-ratio**
Neighbourhood means						
Intercept	1.147***	0.018	63.1	1.140***	0.041	27.6
Lower-middle low income	...	...	...	-0.000	0.045	-0.0
Upper-middle low income	...	...	...	-0.029	0.047	-0.6
Highest low income	...	...	...	-0.004	0.079	-0.0
Lower-middle income inequality	...	...	...	-0.008	0.046	-0.2
Upper-middle income inequality	...	...	...	0.041	0.052	0.8
Greatest income inequality	...	...	...	0.043	0.052	0.8
Individual characteristics						
Low-income status	0.328***	0.054	6.0	0.329***	0.075	4.4
Income not reported	-0.089*	0.033	-2.7	-0.089*	0.036	-2.4
Age	0.028***	0.001	25.5	0.028***	0.001	25.3
Female	0.350***	0.033	10.8	0.350***	0.033	10.8
High school graduation or more	-0.164***	0.039	-4.2	-0.167***	0.039	-4.3
Alcohol dependence	0.099**	0.032	3.1	0.098**	0.032	3.1
Daily smoker	0.089*	0.045	2.0	0.089*	0.045	2.0
Physical inactivity	-0.026	0.021	-1.2	-0.024	0.021	-1.1
Perceived emotional support	-0.096***	0.030	-3.2	-0.095**	0.031	-3.1
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.065	796	1143.8***	0.066	790	1140.4***
Individual level	1.687	...	...	1.687	...	...

Data sources: *1996/97 National Population Health Survey, cross-sectional sample, Health file; 1996 Census of Population*

* $p \leq 0.05$

** $p \leq 0.01$

*** $p \leq 0.001$

Table B
Hierarchical linear models for individual level of distress, Toronto census metropolitan area, 1996/97

Step 1 (unadjusted)	**Model 1: One-way ANOVA**			**Model 2: Means-as-outcome**		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standard error**	**t-ratio**
Neighbourhood means						
Intercept	2.236***	0.041	55.2	2.214***	0.100	22.1
Lower-middle low income	...	...	...	0.169	0.103	1.6
Upper-middle low income	...	...	...	0.251*	0.113	2.2
Highest low income	...	...	...	0.393*	0.163	2.4
Lower-middle income inequality	...	...	...	-0.141	0.119	-1.2
Upper-middle income inequality	...	...	...	-0.162	0.126	-1.3
Greatest income inequality	...	...	...	-0.318*	0.119	-2.7
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.369	796	1143.8***	0.352	790	1122.2***
Individual level	8.783	...	...	8.783	...	...
Step 2 (adjusted for individual low-income status)	**Model 1: One-way ANCOVA**			**Model 2: Means-as-outcome**		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standard error**	**t-ratio**
Neighbourhood means						
Intercept	2.245***	0.040	55.7	2.283***	0.101	22.5
Lower-middle low income	...	...	...	0.143	0.103	1.4
Upper-middle low income	...	...	...	0.162	0.112	1.4
Highest low income	...	...	...	0.218	0.160	1.4
Lower-middle income inequality	...	...	...	-0.145	0.119	-1.2
Upper-middle income inequality	...	...	...	-0.168	0.126	-1.3
Greatest income inequality	...	...	...	-0.334*	0.119	-2.8
Individual characteristics						
Low-income status	1.156***	0.187	6.2	1.146***	0.188	6.1
Income not reported	-0.158	0.087	-1.8	-0.161	0.087	-1.9
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.366	796	1146.9***	0.354	790	1128.1***
Individual level	8.671	...	...	8.672	...	...
Step 3 (adjusted for individual low-income status, age, sex, education, alcohol dependence, smoking, physical inactivity, emotional support)	**Model 1: One-way ANCOVA**			**Model 2: Means-as-outcome**		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standarderror**	**t-ratio**
Neighbourhood means						
Intercept	2.230***	0.038	58.05	2.281***	0.097	23.6
Lower-middle low income	...	...	...	0.125	0.099	1.3
Upper-middle low income	...	...	...	0.078	0.107	0.7
Highest low income	...	...	...	0.012	0.155	0.1
Lower-middle income inequality	...	...	...	-0.094	0.114	-0.8
Upper-middle income inequality	...	...	...	-0.180	0.121	-1.5
Greatest income inequality	...	...	...	-0.217	0.114	-1.9
Individual characteristics						
Low-income status	0.861***	0.182	4.7	0.872***	0.183	4.8
Income not reported	-0.203*	0.084	-2.4	-0.205*	0.084	-2.4
Age	-0.019***	0.002	-8.2	-0.019***	0.002	-8.1
Female	0.657***	0.076	8.7	0.659***	0.076	8.7
High school graduation or more	-0.288**	0.100	-2.9	-0.281**	0.100	-2.8
Alcohol dependence	0.431***	0.096	4.5	0.433***	0.096	4.5
Daily smoker	0.584***	0.113	5.2	0.583***	0.112	5.2
Physical inactivity	0.050	0.047	1.1	0.047	0.047	1.0
Perceived emotional support	-0.654***	0.082	-7.9	-0.656***	0.082	-8.0
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.314	796	1114.8***	0.311	790	1103.7***
Individual level	8.222	...	...	8.224	...	...

Data sources: *1996/97 National Population Health Survey, cross-sectional sample, Health file; 1996 Census of Population*
* $p \leq 0.05$
** $p \leq 0.01$
*** $p \leq 0.001$

Table C
Hierarchical linear models for individual self-perceived health, Toronto census metropolitan area, 1996/97

Step 1 (unadjusted)	**Model 1: One-way ANOVA**			**Model 2: Means-as-outcome**		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standard error**	**t-ratio**
Neighbourhood means						
Intercept	2.182***	0.013	165.3	2.109***	0.027	77.6
Lower-middle low income	...	...	...	0.086**	0.029	2.9
Upper-middle low income	...	...	...	0.187***	0.033	5.7
Highest low income	...	...	...	0.275***	0.056	4.9
Lower-middle income inequality	...	...	...	-0.017	0.035	-0.5
Upper-middle income inequality	...	...	...	-0.054	0.040	-1.4
Greatest income inequality	...	...	...	-0.112**	0.036	-3.1
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.042	796	1190.9***	0.037	790	1126.3***
Individual level	0.893	...	...	0.891	...	...
Step 2 (adjusted for individual low-income status)	**Model 1: One-way ANCOVA**			**Model 2: Means-as-outcome**		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standard error**	**t-ratio**
Neighbourhood means						
Intercept	2.183***	0.013	166.8	2.133***	0.027	77.9
Lower-middle low income	...	...	...	0.074*	0.029	2.5
Upper-middle low income	...	...	...	0.154***	0.033	4.7
Highest low income	...	...	...	0.216***	0.056	3.9
Lower-middle income inequality	...	...	...	-0.018	0.035	-0.5
Upper-middle income inequality	...	...	...	-0.056	0.040	-1.4
Greatest income inequality	...	...	...	-0.117**	0.037	-3.2
Individual characteristics						
Low-income status	0.415***	0.057	7.3	0.394***	0.058	6.8
Income not reported	-0.030	0.029	1.0	0.026	0.029	0.9
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.041	796	1183.1***	0.037	790	1136.4***
Individual level	0.882	...	...	0.881	...	...
Step 3 (adjusted for individual low-income status, age, sex, education, alcohol dependence, smoking, physical inactivity, emotional support	**Model 1: One-way ANCOVA**			**Model 2: Means-as-outcome**		
Fixed effect	**Coefficient**	**Standard error**	**t-ratio**	**Coefficient**	**Standard error**	**t-ratio**
Neighbourhood means						
Intercept	2.198***	0.013	175.0	2.164***	0.027	80.0
Lower-middle low income	...	...	...	0.076**	0.029	2.6
Upper-middle low income	...	...	...	0.138***	0.032	4.4
Highest low income	...	...	...	0.220***	0.052	4.2
Lower-middle income inequality	...	...	...	-0.035	0.033	-1.1
Upper-middle income inequality	...	...	...	-0.076	0.039	-2.0
Greatest income inequality	...	...	...	-0.124**	0.035	-3.5
Individual characteristics						
Low-income status	0.346***	0.053	6.5	0.329***	0.054	6.1
Income not reported	0.016	0.028	0.6	0.014	0.028	0.5
Age	0.012***	0.001	16.2	0.012***	0.001	16.5
Female	0.065**	0.026	2.5	0.064*	0.026	2.5
High school graduation or more	-0.252***	0.030	-8.4	-0.246***	0.030	-8.1
Alcohol dependence	0.085***	0.025	3.4	0.088**	0.025	3.5
Daily smoker	0.164***	0.033	4.9	0.161***	0.033	4.9
Physical inactivity	0.133***	0.015	9.0	0.129***	0.015	8.7
Perceived emotional support	-0.070**	0.023	-3.1	-0.065**	0.023	-2.9
Random effect	**Variance component**	**Degrees of freedom**	**Chi-squared**	**Variance component**	**Degrees of freedom**	**Chi-squared**
Neighbourhood mean	0.036	796	1183.2***	0.033	790	1141.5***
Individual level	0.813	...	...	0.812	...	...

Data sources: *1996/97 National Population Health Survey, cross-sectional sample, Health file; 1996 Census of Population*
** $p \leq 0.05$*
*** $p \leq 0.01$*
**** $p \leq 0.001$*

Table D
Selected characteristics, Toronto census metropolitan area, 1996/97

Variables	Sample size	Weighted frequency distribution or mean (standard deviation)
Neighbourhood		
Neighbourhood low-income rate		
Lowest (2.1%-9.9%)	181	22.7%
Lower-middle (10.0%-19.9%)	258	32.3%
Upper-middle (20.0%-39.8%)	294	36.8%
Highest (40.0%-76.5%)	65	8.2%
Coefficient of variation, family income		
Least inequality (CV=0.44-0.61)	199	24.9%
Lower-middle inequality (CV=0.61-0.70)	200	25.1%
Upper-middle inequality (CV=0.70-0.84)	199	24.9%
Greatest inequality (CV=0.84-3.69)	200	25.1%
Individual		
Number of chronic conditions	8,617	1.11 (1.44)
Distress	8,308	2.25 (3.03)
Self-perceived health	8,682	2.22 (0.99)
Low-income status		
Yes	796	8.7%
No	5,480	61.5%
Income not reported	2,406	29.8%
Age	8,682	40.80 (17.86)
Sex		
Male	4,092	49.0%
Female	4,590	51.0%
Education		
Less than high school	1,834	24.7%
High school graduation or more	6,741	75.3%
Alcohol dependence	8,682	0.10 (0.51)
Daily smoker		
Yes	7,045	17.3%
No	1,637	82.8%
Physical inactivity	8,473	2.40 (0.78)
Perceived emotional support	8,682	3.80 (0.66)

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

Validity of self-reported prescription drug insurance coverage

Paul Grootendorst, Edward C. Newman and Mitchell A.H. Levine

Abstract

Objectives

This article assesses the validity of prescription drug insurance coverage as self-reported in the 1996/97 National Population Health Survey (NPHS).

Data source

The data are from the cross-sectional household component of Statistics Canada's 1996/97 NPHS.

Analytical techniques

Most seniors and all social assistance recipients are entitled to prescription drug benefits from their provincial governments. For NPHS respondents eligible for such benefits, the percentage reporting coverage in 1996/97 was calculated. Logit regression was used to assess the determinants of self-reported coverage.

Main results

Only 51% of seniors and 46% of social assistance recipients who were eligible for provincial benefits reported drug insurance coverage in 1996/97. The probability of reporting coverage was generally higher in provinces with drug programs that did not impose deductibles.

Key words

survey validity, self-report, seniors, social assistance recipients

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The question of public subsidies for prescription drugs is being debated in both Canada[1] and the United States. Canada does have a national health program, but it covers only prescription drugs received in hospital. Provincial governments, however, provide drug benefits to most seniors, low-income individuals and other groups with high drug costs relative to income.[2] The recent National Forum on Health called for the extension of drug benefits to all residents, regardless of age or income.[3]

The increased policy interest in this area has created a need for data on the number and characteristics of those with different levels of prescription drug coverage. Statistics Canada's National Population Health Survey (NPHS) is a potentially useful source, because it represents the population of all provinces and contains recent information on prescription drug insurance, the use of health care services, health status and socio-economic characteristics (see *Data source*). Evidence from the United States, however, casts doubt on the validity of self-reported health insurance.[4-6]

To assess the quality of prescription drug insurance data from the 1996/97 NPHS, this article presents rates of self-reported coverage for those seniors and social assistance recipients who were eligible for premium-free drug benefits under provincial government programs (see *Analytical techniques, Definitions* and *Limitations*). If respondents were well informed, virtually all of them should have reported having some type of insurance, and the percentage should not differ substantially by province.

For several reasons, however, NPHS respondents who had provincial drug coverage might fail to report it. The NPHS asks about prescription medication "insurance," regardless of source, and some people might not realize that provincial drug coverage is a form of insurance. Respondents' awareness of coverage likely varies with their use of prescription drugs and receipt of benefits; those not using any medications might have less knowledge of the provincial program. And if provincial plans have high deductibles, individuals who purchased few drugs may not consider themselves to be covered. Therefore, in this analysis, factors associated with reporting coverage, such as socio-economic characteristics, the presence of chronic conditions, the number of medications taken and proxy reporting, are explored.

Provincial drug insurance programs

While most seniors and all social assistance recipients receive some coverage from their provincial prescription drug benefit programs, the level of coverage and cost-sharing requirements vary by province.

Data source

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

This analysis of prescription drug insurance coverage among seniors and social assistance recipients uses cross-sectional NPHS data from cycle 2, conducted in 1996/97. The data pertain to the household population in the 10 provinces.

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

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

In households belonging to the cross-sectional buy-in component, one knowledgeable household member provided the socio-demographic and health information about everyone in the household 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 belonging to the longitudinal component, the person providing in-depth health information about himself or herself 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 cycle 2 (1996/97).

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

A more detailed description of the NPHS design, sample and interview procedures is available in published reports.[7,8]

The sample sizes for this analysis are 13,363 respondents who were aged 65 or older, and 2,033 respondents aged 18 to 64 who were social assistance recipients.

In 1996/97, all provinces required seniors to pay a portion of their drug costs (Appendix Table A). Except in Ontario, New Brunswick and Prince Edward Island, cost sharing was a percentage of the drug ingredient cost and/or dispensing fees. Newfoundland, Prince Edward Island, New Brunswick (high income), Ontario and Alberta did not stipulate a maximum beneficiary contribution, although with the exception of Newfoundland, each of these provinces limited beneficiary contributions per prescription.

Drug coverage for social assistance recipients is the most comprehensive of all beneficiary-specific provincial drug programs (Appendix Table B). In 1996/97, Newfoundland, Prince Edward Island, Manitoba and British Columbia required no cost sharing. Co-payments in other provinces ranged from $2 in Ontario, Saskatchewan and Alberta to $4 in New Brunswick. Québec imposed monthly deductibles and co-insurance rates subject to monthly out-of-pocket payment maximums.

Half report coverage

Just 51% of seniors who were eligible for premium-free provincial drug benefits reported to the 1996/97 NPHS that they had insurance to cover all or part of the cost of their prescription medications (Table 1). The figure was higher (73%) for seniors who were either ineligible for coverage (high-income seniors in Newfoundland), or who were required to pay premiums (Nova Scotian and high-income New Brunswick seniors). There were no systematic differences in rates of reported coverage among seniors who resided in provinces that required enrolment in the drug plan (Alberta, Manitoba, Nova Scotia and New Brunswick) relative to those who did not.

The percentage of seniors who were eligible for provincial benefits and who reported that they had prescription drug insurance was highest in Alberta (74%), British Columbia (69%) and New Brunswick (low income) (63%), and lowest in Québec (24%), Saskatchewan (30%) and Manitoba (34%).

Although social assistance recipients were eligible for drug benefits in each province, they also tended to under-report. Overall, in 1996/97, 46% reported having some form of insurance. Percentages ranged from a low of 29% in Québec to a high of 63% in Nova Scotia (Table 2).

Of course, the likelihood that people who are entitled to provincial drug benefits will report coverage depends on their awareness of the programs and provisions of the plans. This

Table1
Percentage of seniors reporting drug insurance coverage, 1996/97 National Population Health Survey, by province, household population

	Reporting coverage	Total seniors
	%	'000
Total (premium-free)	**51**	**3,262.5**
Newfoundland - low income	51	53.0
Prince Edward Island	55	16.9
New Brunswick - low income	63	86.1
Québec	24	832.6
Ontario	60	1,282.0
Manitoba	34	142.6
Saskatchewan	30	137.5
Alberta	74	252.9
British Columbia	69	458.9
Total (premium required or ineligible for provincial coverage)	**73**	**122.0**
Newfoundland - high income	81	3.8
Nova Scotia	73	113.5
New Brunswick - high income	66	4.7

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

Table 2
Percentage of social assistance recipients aged 18 to 64 reporting drug insurance coverage, 1996/97 National Population Health Survey, by province, household population

	Reporting coverage	Total social assistance recipients
	%	'000
Total	**46**	**741.5**
Newfoundland	37	29.6
Prince Edward Island	33	1.8
Nova Scotia	63	33.0
New Brunswick	48	27.4
Québec	29	278.7
Ontario	59	222.0
Manitoba	55	21.5
Saskatchewan	54	23.2
Alberta	57	23.9
British Columbia	57	80.4

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

Analytical techniques

The National Population Health Survey (NPHS) contains the question: "Do you have insurance that covers all or part of the cost of your prescription medications? (Include any private, government or employer-paid plans)." During the survey period of the 1996/97 NPHS (June 1996 to August 1997), all provinces provided drug coverage to social assistance recipients, and most did to seniors.[9]

To assess the validity of self-reported drug insurance status, all seniors (65 or older) and social assistance recipients (those who reported "provincial or municipal social assistance or welfare" as their primary source of household income over the previous 12 months and were 18 to 64 years of age) were selected. Each subject's provincial drug insurance program was identified, based on his or her province of residence. For each combination of provincial drug plan and beneficiary group (senior, social assistance), the proportion of subjects reporting drug insurance coverage was tabulated. Estimates were weighted to represent the populations at the date of the survey.

All the provincial drug plans automatically provide coverage to social assistance recipients without requiring special enrolment or registration. However, for seniors in Alberta, Manitoba, Nova Scotia and New Brunswick, the drug plans mail an application package to individuals before their 65th birthday, and eligibility for benefits is contingent on completion of these applications.

During the 1996/97 NPHS survey period, not all seniors were eligible for provincial coverage, and some who were eligible may not have enrolled because premiums were required, or because registration was required. Although these individuals may not have received public coverage, they were included in the analysis for comparison purposes. Newfoundland seniors who did not receive the Guaranteed Income Supplement (GIS) were part of this group, as they were ineligible for provincial coverage; those who were eligible were identified by the report of Old Age Security and GIS as their main source of household income over the previous 12 months. New Brunswick seniors who did not receive the GIS and whose household income exceeded marital status-specific income thresholds had the option of purchasing government-subsidized coverage through Blue Cross. Because this was voluntary and required the payment of premiums, not all seniors would have been covered. It was difficult to identify this group, because the NPHS income intervals do not coincide with the provincial income thresholds. Conservatively, for this analysis, seniors not receiving the GIS were categorized as ineligible for drug benefits, although some would have been. Premiums were also required of Nova Scotia seniors, although those receiving GIS benefits would have been reimbursed. Starting January 1, 1997, Québec required seniors to pay premiums for provincial drug coverage. Those who opted out were required to obtain insurance with minimum coverage standards elsewhere.

For several reasons, NPHS respondents who had provincial drug coverage might fail to report it. The NPHS asks about prescription medication "insurance," regardless of source, and some subjects might not realize that provincial drug coverage is, in fact, a form of insurance. Some respondents may not recall that they have coverage. Recall likely varies with an individual's use of prescription drugs and receipt of benefits; those not using prescription drugs may have less knowledge of the program. And if provincial coverage has high deductibles, individuals who have purchased relatively few drugs may be unaware of the availability of coverage.

To assess the determinants of reporting drug insurance coverage, models of the probability that it was reported were estimated as a function of the respondent's characteristics. Separate models were estimated for seniors and social assistance recipients. The models included covariates that are likely associated with awareness of provincial drug programs because of a medical need for prescription drugs: number of chronic conditions and use of prescription drugs in the two days before the interview (see *Definitions).* Provincial drug plan indicator variables were included to control for the comprehensiveness of provincial benefits, which varies widely.[9] Indicators for each of the previously identified groups of seniors that might not have received provincial coverage were also added.

Subjects with supplementary private insurance might respond positively to the drug insurance question. Categories of gross annual household income, logarithm of household size, sex and marital status were included in the model, as these factors, particularly income, are likely associated with private drug insurance.

Because recall ability could affect response accuracy, the model included age[10] and highest level of education. Given that proxy reporters may be more or less likely to report with error,[11] an indicator of proxy response was also included.

Probability models were estimated using logit regression; the standard errors of the parameter estimators were modified to account for the cluster sampling frame of the NPHS,[6] using the robust covariance matrix estimators programmed in Stata version 6.0.[12] Unlike conventional estimators, which assume that all observations are independent within clusters, the robust estimators take into account the loss of effective sample size owing to the correlation between latent differences in the propensity to report drug coverage among survey respondents residing within the same clusters. The greater the degree of correlation, the less information gained per cluster and the lower the precision of the estimates. Upon preliminary testing, however, the robust and conventional standard error estimates were very close. This may reflect the distribution of respondents across clusters; the average number of observations per cluster in the seniors and social assistance recipients samples was 1.6 and 1.2, respectively. Conventional logit estimators were therefore used (see Appendix Tables C and D for estimates).

After estimation, the way in which the probability of self-reported coverage varies by individual characteristics was predicted. To find the coverage probability for men, for example, the value for the "male" covariate was set equal to 1, and the remaining covariates were set equal to their sample means (Tables 3 and 4). The standard errors for these predictions were estimated using the empirical distribution formed by taking repeated independent draws from the asymptotic distribution of the logit parameter estimates.[13]

awareness, in turn, may depend on individuals' health status and the consequent need for medication, and on other characteristics such as age, sex, marital status, living arrangements, education and income. Even the way in which survey responses are provided—self-reported or by proxy—may influence whether drug insurance coverage is reported.

Determinants of self-reported coverage

When the other selected factors were taken into account, for seniors, greater use of prescription medications was associated with a higher likelihood of reporting drug insurance coverage (Table 3). And as the number of chronic conditions with which seniors had been diagnosed increased, so did their probability of reporting that they had insurance (Appendix Table C). Senior men were marginally but significantly more likely than senior women to report coverage. Seniors living with a spouse had a higher average probability of reporting drug insurance than did those who had never been married.

The literature suggests that proxy reports on behalf of seniors are more accurate than self-reports,[5] and proxy reporting has been found to

Definitions

Prescription drugs are those substances sold under the Food and Drug Act that require a prescription. Respondents to the 1996/97 National Population Health Survey (NPHS) were asked: "Do you have insurance that covers all or part of the cost of your prescription medications? (including private, government or employer-paid plans)."

Premiums are payments made to receive insurance coverage regardless of medication use.

Deductibles refer to drug expenditures paid by the beneficiary before the insurer assumes any costs. The insurer and beneficiary often share drug costs in excess of deductibles. The beneficiary's share can be a fixed amount per prescription (co-payment) or a fixed percentage of the drug cost (co-insurance).

Medication use in past two days is based on responses to questions about prescription drug use in the two days before the NPHS interview: " . . . yesterday and the day before yesterday . . . how many different medications did you take?" and "What is the exact name of the medications that you took?" Prescription-only drugs and non-prescription drugs that could be prescribed (such as insulin) were classified as prescription drugs; over-the-counter drugs and indeterminate drugs (the drug descriptor included a combination of over-the-counter and prescription drugs) were excluded. For this analysis, three categories of prescription medication use in the past two days were established: none, 1 or 2, and 3 or more.

The number of *chronic conditions* that respondents reported (up to 22 were identified in the 1996/97 NPHS) was used as an indication of potential need for prescription drugs. Respondents were asked if they had "any long-term conditions that have lasted or are expected to last six months or more and that have been diagnosed by a health professional." For this analysis, the number of chronic conditions was treated as a continuous variable.

Age (65 or older for seniors and 18 to 64 for social assistance recipients) was also treated as a continuous variable.

Social assistance recipients were identified by a question ascertaining the main source of household income over the past 12 months. Respondents aged 18 to 64 who reported "provincial or municipal social assistance or welfare" as their main source were classified as social assistance recipients.

Respondents were asked their current marital status. For this analysis, three categories were identified: married/common-law, widowed/separated/divorced, and never married.

Household size was used to determine living arrangements and was treated as a continuous variable.

Education was grouped into four categories: less than high school graduation, high school graduation, some postsecondary, and postsecondary graduation.

Household income was based on total annual income. The following income groups were identified for seniors: less than $10,000; $10,000 to $19,999; $20,000 to $29,999; $30,000 to $39,999; $40,000 to $59,999, and $60,000 or more. For social assistance recipients, the groups were: less than $10,000; $10,000 to $19,999; $20,000 to $29,999, and $30,000 or more.

Proxy responses are those obtained for a particular household member from another knowledgeable member of the household, rather than being *self-reported*.

improve response accuracy in a population of cognitively impaired and/or frail elderly.[14] Results from the 1996/97 NPHS are consistent with these findings. Seniors whose responses were proxy-reported had a higher probability of being identified as having coverage than did those who responded on their own behalf.

The probability of seniors reporting drug insurance increased with household income up to the $30,000-to-$39,999 range; beyond that point, the probability of reporting coverage did not continue to increase with income. Seniors with high school or postsecondary graduation were more likely than

Table 3
Mean probabilities of seniors reporting drug insurance coverage, by selected characteristics, 1996/97 National Population Health Survey, household population, Canada excluding territories

	Mean probability	Standard error	95% confidence interval
Sex			
Men	0.593*	0.009	0.576, 0.611
Women†	0.539	0.007	0.524, 0.554
Marital status			
Married/Common-law	0.600*	0.010	0.579, 0.620
Widowed/Separated/Divorced	0.532	0.010	0.512, 0.552
Never married†	0.489	0.023	0.445, 0.533
Education			
Less than high school graduation†	0.545	0.008	0.529, 0.560
High school graduation	0.583*	0.014	0.555, 0.610
Some postsecondary	0.539	0.015	0.510, 0.568
Postsecondary graduation	0.605*	0.013	0.580, 0.629
Household income			
Less than $10,000†	0.465	0.024	0.418, 0.513
$10,000-19,999	0.518*	0.009	0.499, 0.536
$20,000-29,999	0.576*	0.011	0.554, 0.597
$30,000-39,999	0.648*	0.014	0.620, 0.675
$40,000-59,999	0.607*	0.017	0.574, 0.640
$60,000+	0.607*	0.025	0.557, 0.657
Prescription drugs in past 2 days			
0†	0.511	0.008	0.494, 0.527
1-2	0.571*	0.009	0.553, 0.589
3+	0.665*	0.013	0.639, 0.689
Reporting status			
Proxy	0.674*	0.025	0.622, 0.722
Self†	0.556	0.006	0.545, 0.567
Province			
Newfoundland			
Low income	0.526*	0.047	0.434, 0.613
High income	0.597	0.171	0.249, 0.882
Prince Edward Island	0.555	0.040	0.476, 0.631
Nova Scotia	0.671	0.038	0.589, 0.743
New Brunswick			
Low income	0.648	0.038	0.571, 0.718
High income	0.616	0.141	0.312, 0.857
Québec	0.239*	0.024	0.196, 0.287
Ontario†	0.623	0.008	0.608, 0.637
Manitoba	0.338*	0.011	0.317, 0.360
Saskatchewan	0.270*	0.032	0.211, 0.335
Alberta	0.743*	0.012	0.719, 0.766
British Columbia	0.700*	0.030	0.639, 0.756

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
Note: *Model also includes age, logarithm of household size and number of chronic conditions (see Appendix Table C).*
† Reference group
** Significantly different from reference group (p < 0.05)*

Table 4
Mean probabilities of social assistance recipients aged 18 to 64 reporting drug insurance coverage, by selected characteristics, 1996/97 National Population Health Survey, household population, Canada excluding territories

	Mean probability	Standard error	95% confidence interval
Sex			
Men	0.521*	0.025	0.473, 0.570
Women†	0.645	0.015	0.615, 0.673
Marital status			
Married/Common-law	0.551	0.029	0.495, 0.608
Widowed/Separated/Divorced	0.652	0.022	0.608, 0.694
Never married†	0.606	0.020	0.564, 0.645
Education			
Less than high school graduation†	0.602	0.019	0.565, 0.639
High school graduation	0.609	0.031	0.546, 0.668
Some postsecondary	0.618	0.026	0.567, 0.668
Postsecondary graduation	0.615	0.029	0.557, 0.670
Household income			
Less than $10,000†	0.595	0.023	0.550, 0.639
$10,000-19,999	0.619	0.017	0.586, 0.651
$20,000-29,999	0.535	0.053	0.429, 0.635
$30,000+	0.811*	0.080	0.625, 0.930
Prescription drugs in past 2 days			
0†	0.562	0.017	0.530, 0.594
1-2	0.636*	0.023	0.590, 0.681
3+	0.768*	0.032	0.700, 0.827
Reporting status			
Proxy	0.734	0.082	0.554, 0.868
Self†	0.607	0.013	0.583, 0.632
Province			
Newfoundland	0.419*	0.065	0.294, 0.549
Prince Edward Island	0.310*	0.095	0.150, 0.508
Nova Scotia	0.560	0.076	0.407, 0.702
New Brunswick	0.511*	0.074	0.366, 0.654
Québec	0.326*	0.042	0.248, 0.412
Ontario†	0.682	0.016	0.650, 0.712
Manitoba	0.580*	0.034	0.514, 0.646
Saskatchewan	0.620	0.094	0.421, 0.789
Alberta	0.593	0.044	0.505, 0.678
British Columbia	0.619	0.071	0.474, 0.751

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
Note: *Model also includes age, logarithm of household size and number of chronic conditions (see Appendix Table D).*
† Reference group
** Significantly different from reference group(p < 0.05)*

those with less formal education to report having drug insurance.

For social assistance recipients, previous prescription medication use, household income of $30,000 or more, and a higher number of chronic conditions increased the likelihood of reporting drug insurance coverage (Table 4, Appendix Table D). Differences by educational attainment and marital status were not significant. As well, the probability that social assistance recipients would report coverage did not differ significantly by self- or proxy-reports. And unlike the situation among seniors, female social assistance recipients were more likely than their male counterparts to report coverage.

Provincial differences remain

Even when the selected factors were taken into account, substantial provincial differences persisted in the likelihood that seniors and social assistance recipients would report having drug insurance. Compared with Ontario, probabilities for seniors tended to be high in Alberta and British Columbia, and low in Québec, Saskatchewan, Manitoba, and Newfoundland (low-income). For social assistance recipients, rates of reporting prescription drug insurance were low in Prince Edward Island, Québec, Newfoundland, New Brunswick and Manitoba, compared with Ontario (Table 4).

In general, reported rates of coverage among seniors were higher in provinces that did not impose deductibles (British Columbia, Alberta, low-income in New Brunswick, Prince Edward Island and Newfoundland), compared with provinces that did impose deductibles (Manitoba, Saskatchewan, Québec). Those who face deductibles pay all drug expenses up to a certain amount and so may be less likely to realize that they are covered for expenses beyond that threshold.

For example, in 1996/97, the drug programs for seniors in Saskatchewan and Manitoba reimbursed expenditures in excess of sizeable deductibles (up to $850 semi-annually in Saskatchewan and an annual deductible of 2% to 3% of household

Limitations

During the 1996/97 National Population Health Survey (NPHS) period, all the provincial drug plans automatically provided coverage to social assistance recipients—no special enrolment or registration was required. However, identifying seniors who were eligible for provincial drug programs was not straightforward, because the criteria varied from province to province, and even for different groups within provinces (Appendix Table A). As well, some of those who were eligible may have declined to enroll because premiums or registration were required, even if coverage was premium-free.

In Alberta, Manitoba, Nova Scotia and New Brunswick, the provincial drug plans mailed an application package to individuals before their 65th birthday, and eligibility for benefits was contingent upon these application forms being completed and returned. Premiums were also required of Nova Scotia seniors, although those receiving the Guaranteed Income Supplement (GIS) would have had their premiums reimbursed. New Brunswick seniors who did not receive the GIS and whose household income exceeded marital status-specific income thresholds had the option of purchasing government-subsidized drug coverage through Blue Cross. Because this coverage was voluntary and required the payment of premiums, not all seniors would necessarily have been covered. It was difficult to identify this group, because the NPHS income intervals did not coincide with provincial income thresholds. Conservatively, for this analysis, New Brunswick seniors not receiving the GIS were categorized as ineligible for drug benefits, although some would have been entitled to them. In Newfoundland, only seniors who received the GIS were eligible for provincial drug coverage.

Thus, identification of NPHS seniors eligible for drug benefits in some provinces was based on their having reported GIS income during the previous 12 months. But some elderly people who qualified for the GIS may have been unaware of the program, and therefore, failed to apply. They would be included among the group ineligible for prescription drug coverage in this analysis, although their characteristics might more closely resemble those of seniors who were entitled to GIS benefits.

income in Manitoba), but provided relatively comprehensive coverage to social assistance recipients ($2 per prescription in Saskatchewan and free in Manitoba). When the other covariates were held constant, 27% of seniors in Saskatchewan and 34% in Manitoba reported coverage, whereas the corresponding figures for social assistance recipients were 62% and 58%.

In Québec, the only province that required deductibles for social assistance recipients, their reported rate of coverage was markedly lower than that of social assistance recipients in most other provinces. In Prince Edward Island, which also had a low reported rate of coverage, reimbursement was restricted to prescriptions filled in government-run pharmacies; prescriptions filled in commercial pharmacies were not subsidized.

The low reported rates of prescription drug insurance among seniors and social assistance recipients in Québec might also be an artifact of the timing of the 1996/97 NPHS. The interviews, conducted from June 1996 through August 1997, coincided with a period of flux in the provisions of the Régime général d'assurance médicaments, during which premiums, deductibles, co-payments and maximum beneficiary contributions increased substantially.

Concluding remarks

The results of this analysis show substantial under-reporting of prescription drug insurance coverage among 1996/97 National Population Health Survey respondents who were known to be eligible for publicly provided benefits. Only 51% of seniors and 46% of social assistance recipients in provinces with premium-free coverage reported that they had insurance to cover all or part of their costs for prescription medications.

Furthermore, there is evidence that the under-reporting of drug insurance coverage is not restricted to seniors and social assistance recipients. An earlier analysis of 1996/97 NPHS data[14] found that approximately 61% of all household residents in the 10 provinces reported having drug insurance. However, a national study[15] using 1995 enrolment data from private and public health insurers estimated that 88% of Canadians were insured. And a study published in 2000[16] using the same types of data estimated that 90% of Canadians had some drug coverage.

It is noteworthy that the rates of self-reported insurance among seniors who did not have premium-free provincial coverage (and so were likely required to apply and pay premiums for alternative coverage) were over 20 percentage points higher than the rates for those who did receive premium-free provincial benefits (73% versus 51%). This is consistent with evidence from a Wisconsin study.[17] A comparison of self-reported drug insurance with actual coverage from a sample of 351 residents of that state found that 94% correctly identified having private coverage (typically from an employer), but only 7% correctly reported that they had public coverage (Medicare, Medicaid and other sources).

Although it could not be directly tested, use of the word "insurance" in the NPHS questionnaire may be a source of confusion. Provincial drug plan beneficiaries may not recognize that prescription drug subsidies, even if they cover only a part of the cost, are a form of insurance. Certainly, these public subsidies are unlike traditional insurance. Except for Québec, the provincial drug plans do not use the word "insurance" in their names, and among the plans examined, few premiums are payable.

The results of this analysis indicate that self-reported drug insurance should be interpreted cautiously. If survey data are to be used to measure levels of coverage, further research is needed to devise questionnaires that would improve reporting accuracy. ●

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Appendix

Table A

Provincial prescription drug programs for seniors, 1996/97

Province (Program name)	Beneficiary group	Premiums[1]	Deductible	Co-payments and co-insurance[2]	Maximum beneficiary contribution
Newfoundland (Newfoundland and Labrador Prescription Drug Program)	GIS seniors	None	None	Dispensing fee + 10% of ingredient cost > $30	None
	Non-GIS seniors	No coverage	No coverage	No coverage	No coverage
Prince Edward Island (Prince Edward Island Drug Cost Assistance Plan for Seniors)	All seniors	None	None	$14.85;[3] $14.50[3]	None
Nova Scotia (Seniors' Pharmacare)	All seniors[4]	$215 less income-contingent rebate[5]	None	Maximum (20%, $3/prescription)	$200
New Brunswick (New Brunswick Prescription Drug Program)	GIS seniors[6]	None	None	$9.05/prescription	$250
	Low-income seniors[6]	None	None	$9.05/prescription	None
	Other seniors[7]	$58/month	None	$9.05/prescription	None
Quebec (Régime général d'assurance médicaments)[8]	Full GIS seniors[9]	None;[10] $0-$175[11]	None;[10] $25/quarter;[12] $8.33/month[13]	None;[14] 25%[15]	None:[14] $83.33/5 months;[16] $50/quarter;[12] $16.67/month[13]
	Partial GIS seniors	None,[10] $0-$175[11]	None,[10] $25/quarter;[12] $8.33/month[13]	$2/prescription,[14] 25%[15]	$100,[14] $208.33/5 months,[16] $125.00/quarter;[12] $41.67/month[13]
	Non-GIS seniors	None,[10] $0-$175[11]	None,[10] $25/quarter;[12] $8.33/month[13]	$2/prescription,[14] 25%[15]	$100,[14] $312.50/5 months,[16] $187.50/quarter,[12] $62.50/month[13]
Ontario (Ontario Drug Benefit)[17]	Single senior, household income >$16,018; Senior with partner, household income > $24,175[19]	None	$100	$6.11/prescription[18]	None
	Other seniors	None	None	$2/prescription[20]	None
Manitoba (Pharmacare)	Households with adjusted income ≤ $15,000[21]	None	2% of adjusted household income[21]	None	2% of adjusted household income[21]
	Households with adjusted income > $15,000[21]	None	3% of adjusted household income[21]	None	3% of adjusted household income[21]
Saskatchewan (Saskatchewan Prescription Drug Plan)	Seniors on Saskatchewan Income Plan[22]	None	$100 semi-annually	35%	1.7% of adjusted household income semi-annually[23]
	Seniors with some GIS income	None	$200 semi-annually	35%	1.7% of adjusted household income semi-annually[23]
	Non-GIS seniors	None	$850 semi-annually	35%	1.7% of adjusted household income semi-annually[23]
Alberta (Alberta Blue Cross Group 66)	All seniors	None	None	Maximum (30%, $25/prescription)[24]	None
British Columbia (Pharmacare Plan A)	All seniors	None	None	100% of dispensing fee	$200

1 *Unless otherwise stated, premiums, deductibles and maximum contributions applied annually.*
2 *Unless otherwise stated, co-payments and co-insurance rates apply to total prescription, including drug ingredient cost and dispensing fee.*
3 *Co-payments based on estimates of the average dispensing fee charged to seniors after August 1993.*
4 *Beginning in September 1996, seniors could opt out of program.*
5 *Premium is $215 for single non-GIS seniors with income of $18,000 or more, decreasing to $0 with income of $15,000; premium is $215 per senior for married non-GIS seniors with combined income of $24,000 or more, decreasing to $0 with income of $18,000. Seniors who fail to enroll within specified period after receiving notification of program eligibility pay annual premium of $322.50 and face three-month waiting period.*
6 *GIS seniors are those who collect some GIS benefits. Low-income seniors are those who do not collect GIS benefits, but have adjusted household income $17,198 or less if single; $26,955 or less if married to another senior; $32,390 or less if married to non-senior.*
7 *"Other seniors" are those who neither receive GIS benefits nor have sufficiently low income; Blue Cross of Atlantic Canada provides drug coverage to these seniors, regardless of health status, provided they apply within 60 days of 65th birthday. Thereafter, they may face higher premiums or be denied coverage on basis of health.*
8 *Those who opt out of provincial government coverage must enroll in plan with following minimum conditions: no more than 25% co-insurance rate on total prescription cost; no more than $750/year in adult out-of-pocket cost, including drug expenses for dependants younger than 18 and dependent students younger than 26.*
9 *Coverage also applies to non-elderly spouses receiving GIS Spousal Allowance.*
10 *Until end of December 1996*
11 *From January 1997*
12 *January to June 1997*
13 *From July 1997*
14 *Until end of July 1996*
15 *From August 1996*
16 *August to December 1996*
17 *Until July 14, 1996, all seniors received full coverage.*
18 *Seniors in families receiving Trillium Drug Program benefits who have exceeded yearly deductible pay $2 per prescription.*
19 *Household income defined as line 236 of federal income tax form.*
20 *Many pharmacies waive $2 co-payment.*
21 *Adjusted household income is gross income (line 150 of federal Notice of Assessment form) less $3,000 for spouse and each dependant younger than 18.*
22 *Eligibility for Saskatchewan Income Plan requires that Old Age Security and GIS comprise almost all income.*
23 *Maximum contribution applies to individuals who apply and qualify for Special Support program. Adjusted household income is gross household income (line 150 of federal Notice of Assessment form) less $3,500 for each dependant younger than 18.*
24 *Maximum patient co-payment of $25 per prescription does not apply if patient chooses brandname formulation when generic equivalent exists.*

Table B
Provincial prescription drug programs for social assistance recipients aged 18 to 64, 1996/97

Province (Program name)	Premiums	Deductible	Co-payments and co-insurance[1]	Maximum beneficiary contribution
Newfoundland (Newfoundland and Labrador Prescription Drug Program)	None	None	None	None
Prince Edward Island (Prince Edward Island Drug Cost Assistance Plan)	None[2]	None	None	None
Nova Scotia (Pharmacare for Income Assistance)	None	None	$3/prescription	None
New Brunswick (New Brunswick Prescription Drug Program)	None	None	$4/prescription for adults; $2/prescription for children younger than 18	$250/family
Quebec (Programme de médicaments et des services pharmaceutiques)[3]	None	None;[4] $25/quarter;[6] $8.33/month[7]	25%[5]	$83.33/5 months;[5] $50/quarter;[6] $16.67/month[7]
Ontario (Ontario Drug Benefit Program)	None	None	$2/prescription[8]	None
Manitoba (Social Allowance Health Services)	None	None	None	None
Saskatchewan (Saskatchewan Assistance Plan)[9]	None	None	$2/prescription	None
Alberta (Social Services Prescription Drug Services for Social Allowance and Child Welfare)	None	None	None	None
British Columbia (Pharmacare Plan C)	None	None	None	None

[1] Unless otherwise stated, co-payments and co-insurance rates apply to total prescription, including drug ingredient cost and dispensing fee.
[2] No charge if filled at government pharmacy; $2 charge if filled at community pharmacy.
[3] Social assistance recipients' dependants younger than 18 receive full coverage.
[4] Until end of December 1996
[5] Starting August 1996
[6] January to June 1997
[7] From July 1997
[8] None before July 15, 1996
[9] Dependants younger than 18 of Saskatchewan Assistance Plan beneficiaries receive full coverage; such beneficiaries who require "expensive, long-term medications" and others such as unwed mothers, inmates, and transients receive full coverage.

Table C

Logit model estimates of probability of seniors reporting drug insurance coverage, by selected characteristics, 1996/97 National Population Health Survey, household population, Canada, excluding territories

	Coefficient	z	P>|z|	95% confidence interval
Age	-0.007	-1.827	0.068	-0.014, 0.000
Men	0.220	4.509	0.000	0.124, 0.315
Married/Common-law	0.448	4.163	0.000	0.237, 0.659
Widowed/Separated/ Divorced	0.172	1.813	0.070	-0.014, 0.357
High school graduation	0.156	2.381	0.017	0.028, 0.285
Some postsecondary	-0.023	-0.331	0.741	-0.156, 0.111
Postsecondary graduatio	0.248	3.935	0.000	0.124, 0.371
$10,000-19,999	0.212	2.089	0.037	0.013, 0.411
$20,000-29,999	0.447	4.141	0.000	0.235, 0.658
$30,000-39,999	0.750	6.365	0.000	0.519, 0.981
$40 000-59 999	0.577	4.682	0.000	0.335, 0.818
$60 000+	0.576	3.924	0.000	0.288, 0.863
Household size (log)	-0.354	-3.909	0.000	-0.531, -0.176
Number of chronic conditions	0.066	5.207	0.000	0.041, 0.090
1-2 prescription drugs in past 2 days	0.244	4.817	0.000	0.144, 0.343
3+ prescription drugs in past 2 days	0.641	9.370	0.000	0.507, 0.775
Proxy reporter	0.499	4.177	0.000	0.265, 0.733
Newfoudland (low income)	-0.402	-2.106	0.035	-0.775, -0.028
Newfoudland (high income)	-0.058	-0.073	0.942	-1.617, 1.500
Prince Edward Island	-0.280	-1.677	0.094	-0.607, 0.047
Nova Scotia	0.219	1.231	0.219	-0.130, 0.569
New Brunswick (low income)	0.112	0.649	0.516	-0.225, 0.449
New Brunswick (high income)	0.018	0.027	0.978	-1.263, 1.299
Québec	-1.659	-12.284	0.000	-1.924, -1.395
Manitoba	-1.171	-19.988	0.000	-1.286, -1.057
Saskatchewan	-1.498	-8.958	0.000	-1.826, -1.171
Alberta	0.564	8.051	0.000	0.427, 0.701
British Columbia	0.351	2.441	0.015	0.069, 0.634
Intercept	-0.099	-0.334	0.738	-0.680, 0.482

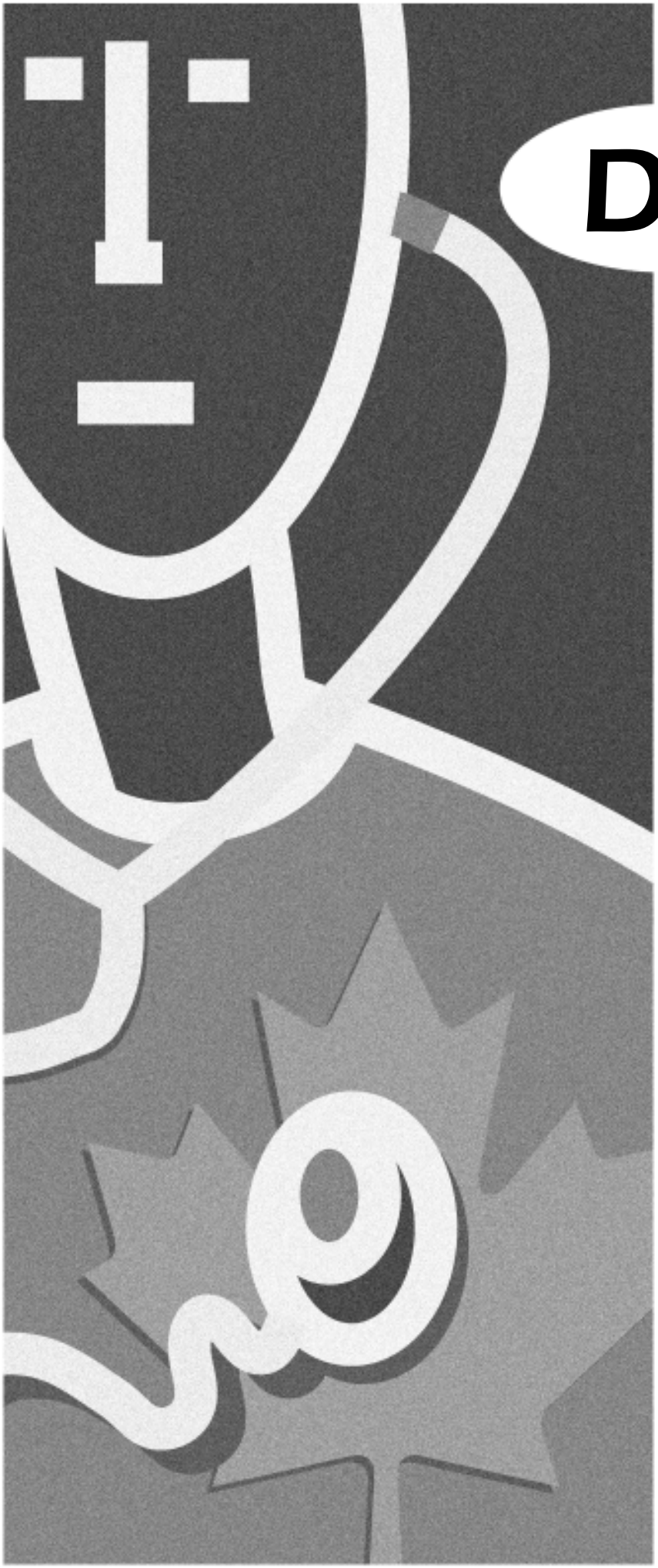
Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
Notes: *Pseudo R^2 = 0.1011; number of observations = 9,603.*

Table D

Logit model estimates of probability of social assistance recipients aged 18 to 64 reporting drug insurance coverage, by selected characteristics, 1996/97 National Population Health Survey, household population, Canada excluding territories

	Coefficient	z	P>|z|	95% confidence interval
Age	-0.009	-1.630	0.103	-0.020, 0.002
Men	-0.511	-4.225	0.000	-0.748, -0.274
Married/Common-law	-0.223	-1.435	0.151	-0.527, 0.082
Widowed/Separated/ Divorced	0.199	1.455	0.146	-0.069, 0.466
High school graduation	0.026	0.166	0.868	-0.278, 0.330
Some postsecondary	0.066	0.484	0.628	-0.200, 0.331
Postsecondary graduation	0.053	0.362	0.717	-0.234, 0.340
$10,000-19 999	0.102	0.831	0.406	-0.139, 0.344
$20 000-29 999	-0.242	-1.000	0.318	-0.718, 0.233
$30,000+	1.162	2.123	0.034	0.089, 2.235
Household size (log)	0.181	1.447	0.148	-0.064, 0.425
Number of chronic conditions	0.136	4.445	0.000	0.076, 0.196
1-2 prescription drugs in past 2 days	0.309	2.501	0.012	0.067, 0.551
3+ prescription drugs in past 2 days	0.959	4.788	0.000	0.567, 1.352
Proxy reporter	0.632	1.478	0.140	-0.206, 1.471
Newfoundland	-1.092	-3.880	0.000	-1.644, -0.541
Prince Edward Island	-1.599	-3.443	0.001	-2.510, -0.689
Nova Scotia	-0.512	-1.585	0.113	-1.145, 0.121
New Brunswick	-0.719	-2.264	0.024	-1.341, -0.096
Québec	-1.498	-7.298	0.000	-1.900, -1.095
Manitoba	-0.438	-2.801	0.005	-0.744, -0.131
Saskatchewan	-0.255	-0.608	0.543	-1.075, 0.565
Alberta	-0.381	-1.945	0.052	-0.766, 0.003
British Columbia	-0.266	-0.830	0.407	-0.895, 0.363
Intercept	0.523	2.067	0.039	0.027, 1.019

Data source: *1996/97 National Population Health Survey, cross-sectional sample, Health file*
Notes: *Pseudo R^2 = 0.0868; number of observations = 1,765.*



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Health Indicators, 2002(2)

The most recent version of *Health Indicators* includes data from the 2000/01 Canadian Community Health Survey (CCHS). Information on self-esteem, social support, influenza immunization, and decision-making latitude at work is now available for selected health regions. These indicators supplement the highlights, maps and data tables presented in every volume. All indicators based on CCHS data have been updated to reflect the new health region boundaries in British Columbia.

Health Indicators (82-221-XIE) is available free on Statistics Canada's Web site (www.statcan.ca). From the "Our products and services" page, select "Free publications," then "Health." 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.

Comparable Health Indicators, 2002

Comparable health indicators for Canada, the provinces and the territories are available on the Statistics Canada and Canadian Institute for Health Information Web sites. Health ministries from the provinces and territories and the federal government have identified several indicators that address health status, outcomes of health services, and quality of health services: life expectancy; infant mortality; low birth rate; self-reported health; change in life expectancy; improved quality of life; reduced burden of disease, illness and injury; waiting times for key diagnostic and treatment services; patient satisfaction; hospital re-admission for selected conditions; access to first-contact health services; home and community care services 24 hours a day and seven days a week; public health surveillance and protection; and health promotion and disease prevention.

Comparable Health Indicators (82-401-XIE) is available free on Statistics Canada's Web site (www.statcan.ca). From the "Our products and services" page, choose "Free publications," then "Health." For more information, or to enquire about concepts, methods or data quality, contact Brenda Wannell (613-951-8554; brenda.wannell@statcan.ca), Health Statistics Division, Statistics Canada.

Cancer incidence, 2000

Preliminary data on cancer incidence in 2000 are available for the provinces and territories, with the exceptions of Québec, Newfoundland, Labrador. The data include information on new cases diagnosed in 2000 as reported by the provincial and territorial cancer registries. National data for 1999 are available.

For more information, contact Client Custom Services (613-951-1746; hd-ds@statcan.ca) or Michel Cormier (613-951-1775), Health Statistics Division, Statistics Canada.

Births, 2000

For the tenth consecutive year, the number of births fell in 2000. A total of 327,882 babies were born, down 2.8% from 1999 and the lowest number since 1946. The number of live births declined in all provinces and territories except the Northwest Territories, where it rose 2.1%.

Combined with a larger population, the drop in live births left the fertility rate—an estimate of the average number of children that women aged 15 to 49 will have in their lifetime—at a record low of 1.49. Rates fell for women in all age groups under 35.

The largest decrease in the fertility rate was among teenagers: 17.3 births for every 1,000 women aged 15 to 19, down from 18.9 births in 1999. Although fertility rates among women aged 35 or older rose between 1999 and 2000, the increases were not large enough to offset the decreased rates among younger women.

For more information, or to order custom tabulations, contact Client Custom Services (613-951-1746; hd-ds@statcan.ca). To enquire about concepts, methods or data quality, contact Patricia Tully (613-951-1759; patricia.tully@statcan.ca), Health Statistics Division, Statistics Canada.

Divorces, 1999 and 2000

A total of 71,144 couples formally divorced in 2000, up slightly (0.3%) over 1999. Most couples (60%) who divorced in 1999 and 2000 had been married for less than 15 years.

The number of divorces for every 100,000 people in the population, or the crude divorce rate, rose in 1999 to 232.5, and dropped a marginal 0.6% to 231.2 in 2000.

Custody of dependants, mostly children aged 18 or younger, was granted in one out of every three divorces in both 1999 and 2000. In 2000, custody was determined through divorce proceedings for 37,000 dependants. The 14-year trend toward joint custody continued, with custody for 37.2% of dependants being awarded to both parents that year. Custody was awarded to the mother only for 53.5% of dependants, and to the father only for 9.1%.

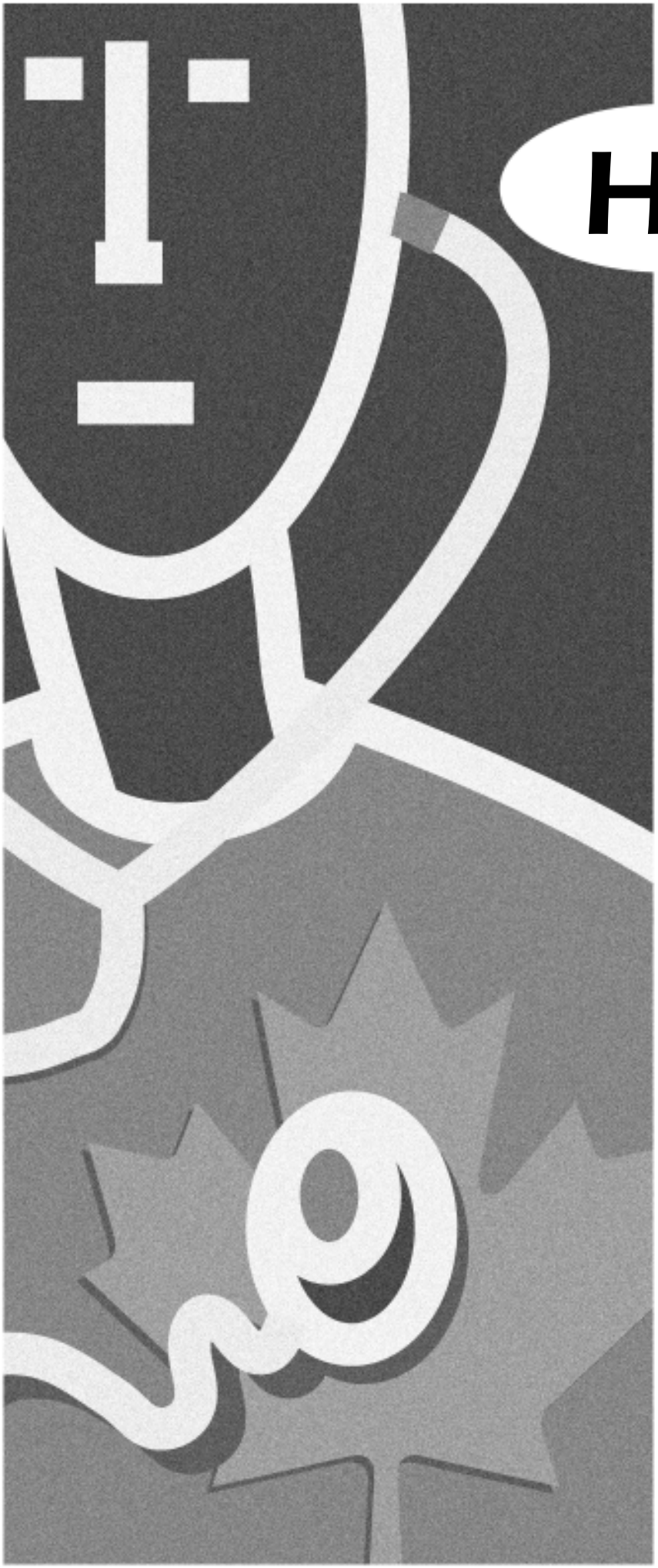
To order the shelf tables, *Divorces, 1999 and 2000* (84F0213XPB, $20), or custom tabulations, contact Client Custom Services (613-951-1746; hd-ds@statcan.ca). For more information, or to enquire about concepts, methods or data quality, contact Patricia Tully (613-951-1759; patricia.tully@statcan.ca) or Leslie Geran (613-951-5243; leslie.geran@statcan.ca), Health Statistics Division, Statistics Canada.

Life Tables, Canada, Provinces and Territories, 1995-1997

Life tables for 1995 to 1997, with life expectancy by age and sex for Canada, the provinces, and Nunavut, the Yukon and the Northwest Territories combined, are now available.

Detailed estimates by single year of age are presented for Canada and every province except Prince Edward Island. Because of their small populations and low death counts, abridged estimates by five-year age group are provided for PEI and for the combined territories. The publication contains an extensive description of the methodology used to produce the estimates, as well as coefficients of variation for the life expectancies. Whenever possible, each complete life table was extended to age 109. The abridged life tables extend to 100 years plus.

Life Tables, Canada, Provinces and Territories, 1995-1997 (84-537-XIE) is available free on Statistics Canada's Web site (www.statcan.ca). From the "Our products and services" page, choose "Free publications," then "Population and demography." For more information, or to enquire about concepts, methods or data quality, contact Patricia Tully (613-951-1759; patricia.tully@statcan.ca), Health Statistics Division, Statistics Canada. ●



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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
How Healthy are Canadians? Annual Report 2002		82-003-SIE 82-003-SPE	Internet Paper	Free $20
Health Indicators, electronic publication		82-221-XIE	Internet	Free
Comparable health indicators - Canada, provinces and territories		82-401-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 in Canada, 1985 to 2001		82F0077-XIE	Internet	Free
Health Care in Canada 2000 – A First Annual Report		82-222-XIE (and http://www.cihi.ca)	Internet	Free
Canadian Community Health Survey				
Access to health care services in Canada, 2001		82-575-XIE	Internet	Free
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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
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Canadian Classification of Diagnostic, Therapeutic and Surgical Procedures and Treatments		82-562-XPB	Paper	$40
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Life Tables, Canada, Provinces and Territories, 1995-1997		84-537-XIE	Internet	$15

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

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
(See also section on Microdata files)			
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Occupational Surveillance in Canada: Cause-specific mortality among workers, 1965-1991	84-546-XCB	CD-ROM	$500
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Residential Care Facilities, 1998-99 *(These data are available as custom tabulations through the Client Custom Services Unit.)*			
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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

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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.

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Email: HD-DS@statcan.ca

Canadian Community Health Survey		Product number	Format	Price (CAN$)†‡
Canadian Community Health Survey, 2000-2001 - Cycle 1.1 PUMF (public-use microdata file)		82M0013XCB	CD-ROM	$2,000
Cross-sectional data in Flat ASCII files, User's Guide, data dictionary, indexes, layout, Beyond 20/20 Browser for the Health File				Free for Health Sector
National Population Health Survey public-use microdata files				
Cycle 4, 2000-01				
Custom tables	Household	82C0013	Price varies with information requirements	
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.

POPULATION HEALTH SURVEYS

Canadian Community Health Survey (CCHS)

Cycle 1.1: CCHS was conducted by Statistics Canada to provide cross-sectional estimates of health determinants, health status and health system utilization for 133 health regions across Canada, plus the territories.

Cycle 1.2: CCHS-Mental Health and Well-being is being conducted by Statistics Canada to provide provincial cross-sectional estimates of mental health determinants, mental health status and mental health system utilization.

Cycle 2.1: CCHS will be conducted by Statistics Canada to provide cross-sectional estimates of health determinants, health status and health system utilization for 134 health regions across Canada.

National Population Health Survey (NPHS)

Household - The household component includes household residents in all provinces, with the principal exclusion of populations on Indian Reserves, Canadian Forces Bases and some remote areas in Québec and Ontario.

Institutions - The institutional component includes long-term residents (expected to stay longer than six months) in health care facilities with four or more beds in all provinces with the principal exclusion of the Yukon and the Northwest Territories.

North - The northern component includes household residents in both the Yukon and the Northwest Territories with the principal exclusion of populations on Indian Reserves, Canadian Forces Bases and some of the most northerly remote areas of the Territories.

Joint Canada - United States Health Survey (JCUHS)

The Joint Canada - United States Health Survey (JCUHS) will collect information from both Canadian and U.S. residents, about their health, their use of health care and their functional limitations.

For more information about these surveys, visit our web site at
http://www.statcan.ca/english/concepts/hs/index.htm

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.