

Health Status and Health Behaviour Among Immigrants

- *Relative to non-immigrants, immigrants had superior health in terms of chronic conditions in general, even when accounting for age, education, and income. Immigrants' odds for reporting any chronic condition increased with time living in Canada.*
- *Newly arrived men had lower odds than non-immigrants of reporting heart disease. The same was true for women and cancer. With respect to diabetes, high blood pressure, heart disease in women, and cancer in men, immigrant and non-immigrant health were comparable; and there was no clear gradient of worsening health with time since immigration.*
- *Health behaviours such as smoking and heavy drinking differed between immigrant and Canadian-born respondents and varied with length of residence in Canada, but these differences did not generally explain the patterns in health outcomes.*

Abstract

Objectives

This article compares the health of immigrants at different times since immigration with that of the Canadian-born population, in terms of chronic conditions in general, heart disease, diabetes, high blood pressure, and cancer. Health behaviour outcomes were also explored, as was their role in explaining observed health outcomes.

Data source

The data are from Statistics Canada's cross-sectional 2000/01 Canadian Community Health Survey. The sample comprised 131,535 household respondents aged 12 or older, representing almost 26 million Canadians.

Analytical techniques

The prevalence of health outcomes and behaviours was estimated for Canadian-born respondents and immigrants, defined by their time since immigration. Logistic regression was used to estimate odds of reporting health outcomes, both unadjusted and adjusted for socio-demographic variables and health behaviours. Odds for reporting health behaviours were also estimated.

Main results

Both male and female immigrants had lower odds of reporting chronic conditions in general, but odds increased with time spent in Canada. Only recently-arrived men had healthier heart disease outcomes than non-immigrant men. The same was true for women and cancer. In all other cases, there appeared to be no health advantage for immigrants, nor a gradient of worsening health with time since immigration. Patterns in health behaviours accounted for very few differences between immigrant and non-immigrant health.

Key words

healthy immigrant effect, chronic conditions, cross-sectional study

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Canada accepts proportionately more immigrants and refugees than any other country.¹ Since World War II, this country has received an average of approximately 150,000 immigrants yearly; since 1990, the yearly average has remained in the 200,000 range.^{1,2} Understanding the health patterns of the immigrant community is important not only because immigrants constitute a sizeable proportion of the population,³ but also because such an understanding can help in analyzing the health of all Canadians.

Methods

Data sources

This analysis uses data from the 2000/01 Canadian Community Health Survey (CCHS), a cross-sectional survey conducted by Statistics Canada. The CCHS collects information on the health of the Canadian population, covering 136 health regions across the country. The sample consists of 131,535 respondents aged 12 or older living in households in all provinces and territories, weighted to represent almost 26 million Canadians (Appendix Table A). The overall response rate for this cycle of the CCHS was 84.7%.

Analytical techniques

Respondents were divided into categories on the basis of their immigration status (versus Canadian-born), length of residence in Canada (see *Definitions*), and by sex. The prevalence of selected health outcomes and health behaviours was estimated for these groups.

Logistic regression models were fitted to estimate the odds of different immigrant groups reporting the presence of chronic conditions, both unadjusted and adjusted for socio-demographic variables (age, education, and household income) and for health behaviours (smoking, overweight and obesity, heavy drinking, physical inactivity, and fruit and vegetable consumption), with Canadian-born respondents as the reference group. Models were also fitted with dichotomous health behaviour variables as outcomes, with and without socio-demographic adjustment. Means were estimated for a continuous scale representing frequency of fruit and vegetable consumption. The least squares method was used to adjust means for socio-demographic factors.

Multiple logistic models were also fitted for the immigrant population only, to examine how well place of origin explained health differences among immigrants, grouped by time since immigration, after adjustment for socio-demographic factors and health behaviours.

Weights were used to account for unequal probabilities of selection. To account for the complex sample design, the bootstrap technique was used to estimate coefficients of variation and to test for statistical significance of differences ($p < 0.05$).

Limitations

The data from the Canadian Community Health Survey (CCHS) are self-reported or proxy-reported, and the degree to which they are inaccurate because of reporting error is unknown.

Although respondents were asked if chronic conditions had been diagnosed by a health care professional, no independent source was available to confirm diagnoses. New immigrants (and other respondents) may experience cultural, linguistic, or other barriers that might deter them from consulting health care professionals, which could lead to under-diagnosis of chronic conditions. Body mass index based on self-reported weight and height may be somewhat inaccurate, especially for people aged 65 or older. Heavy drinkers are defined as those who had more than two alcoholic beverages, on average, per day in the previous week. Respondents who experienced an atypical week of drinking before responding to the survey might have been misclassified. In terms of physical activity, people may expend considerable energy at work or while doing household chores (and the level of energy expenditure may differ between immigrants and non-immigrants and by type of immigrant), but information on non-leisure-time physical activity is not available from the survey. The nutrition questions in the CCHS ask about the number of times any fruits or vegetables are consumed but not about the amount consumed. In addition, significant variations in the performance of these questions have been reported for different ethnic populations in the United States⁴. The nutrition questions have not been tested in specific Canadian sub-populations, and it is possible that response accuracy, and thus the classification of respondents, may vary between ethnic or cultural sub-groups.

Although the health of refugees is significantly poorer than that of other types of immigrants, refugee status is not collected in the CCHS.

The identified place of origin may not be an immigrant's most recent place of residence. Residence in a country other than the country of birth before moving to Canada might dilute findings analyzed according to place of origin. Period of residence in Canada is measured from the date when a respondent first came to live in Canada. However, a person might have left Canada after initial arrival, spent time in other countries, and later returned to Canada, which again might affect the findings.

Finally, responses and response rates for newer immigrants may be affected by linguistic and cultural factors.

Research has revealed that immigrants, especially recent arrivals, enjoy better health than their Canadian-born counterparts.⁵ Although not applicable to certain infectious diseases, such as tuberculosis,⁶ this pattern has been observed to various degrees for outcomes such as chronic diseases, disability, dependency, life expectancy, and disability-free life expectancy.⁷⁻⁹ These findings are consistent with results for other industrialized nations.^{10,11} Moreover, they are not surprising, given that healthier people self-select into the immigration process and candidates for immigration must meet certain health status criteria, as stipulated in the Immigration Act.²

However, many of these studies have also shown that immigrants who have resided in Canada for decades do not enjoy this health advantage.^{7,11} It has been speculated that this is due to a deterioration in the health of immigrants over time, leading to a convergence with the health of the Canadian-born population. The adoption of new health behaviours, such as smoking, during the process of acculturation^{12,13} has also been speculated to play a substantial role in this worsening of health.

Because of sample size considerations, previous studies have been limited in the extent to which they could explore the phenomenon of apparent convergence, with time since immigration, of immigrants' health status with that of the Canadian-born population. This analysis, based on 131,535 respondents (of whom 16,901 were immigrants for whom time since immigration was known) from the 2000/01 cross-sectional Canadian Community Health Survey (CCHS) conducted by Statistics Canada, explores how the health of immigrants compares with that of the Canadian-born population as time since immigration increases, in terms of chronic conditions in general and the specific conditions of heart disease, diabetes, high blood pressure, and cancer. Because these specific conditions are linked with lifestyle factors such as smoking, physical inactivity, and diet, patterns in health behaviours of immigrants are also explored, as is the role of these behaviours in explaining health patterns.

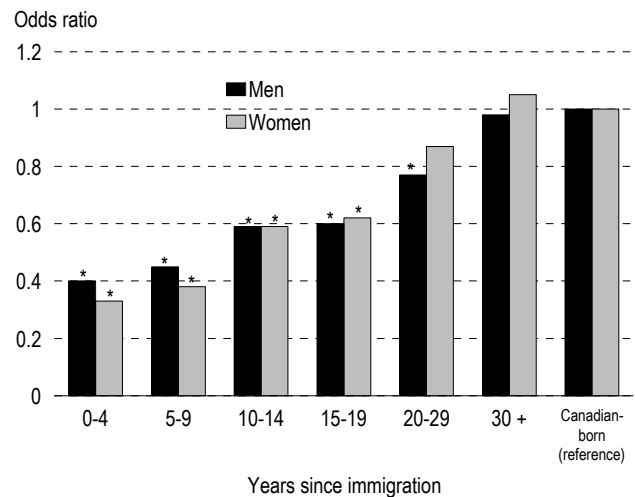
General chronic disease prevalence rises with time since immigration

The results for chronic conditions in general corroborate previous findings based on other survey data,^{7,9} that is, immigrants were healthier overall than non-immigrants. The prevalence of chronic conditions among immigrants was 59.6%, significantly lower than the 65.2% observed for the Canadian-born population (Table 1). Adjusting for differences in age, education,

and income between these two groups widened the gap: the odds ratio for immigrants reporting the presence of chronic conditions, relative to non-immigrants, was 0.79 before and 0.63 after adjustment. The pattern was similar for the two sexes. Although immigrant and non-immigrant women had a higher prevalence of chronic conditions than men, the relative advantage of immigrant women over Canadian-born women was similar to that for men (adjusted odds ratios 0.65 for immigrant men and 0.62 for immigrant women).

The sample size of the CCHS allows for a finer division of immigrants by length of residence than has previously been possible. The results for chronic conditions in general indicate a gradient, the health of immigrants becoming progressively worse with increasing length of residence in Canada (Table 1, Chart 1). In fact, among both men and women, after adjustment for age, education, and income, the odds ratios for reporting a chronic condition, relative to non-immigrants, climbed steadily across groups, with those who had resided in Canada the longest (30 years or more) being indistinguishable from their Canadian-born counterparts. It should be noted that the chronic conditions reported had to have been diagnosed by a health care professional, so these findings may in part reflect differences in doctor consultation rates between immigrants and non-immigrants or some inability among recent immigrants to communicate their health problems.^{14,15}

Chart 1
Odds ratios for chronic conditions in general, by sex and years since immigration, adjusted for age, education, and income



Data source: 2000/01 Canadian Community Health Survey
* Significantly different from the reference category ($p < 0.05$).

Table 1
Prevalence of and odds ratios for selected health outcomes, by sex and years since immigration, household population aged 12 or older, Canada, 2000/01

Condition by years since immigration	All respondents				Men				Women			
	Pre-valence (%) [†]	Unadjusted odds ratio [‡]	Adjusted odds ratio [§]	Adjusted odds ratio ^{¶¶}	Pre-valence (%) [†]	Unadjusted odds ratio [‡]	Adjusted odds ratio [§]	Adjusted odds ratio ^{¶¶}	Pre-valence (%) [†]	Unadjusted odds ratio [‡]	Adjusted odds ratio [§]	Adjusted odds ratio ^{¶¶}
All chronic conditions												
All immigrants	59.6*	0.79*	0.63*	0.65*	54.4*	0.80*	0.65*	0.67*	64.7*	0.77*	0.62*	0.66*
0-4 years	37.4*	0.32*	0.36*	0.35*	33.8*	0.34*	0.40*	0.35*	41.3*	0.29*	0.33*	0.40*
5-9 years	42.7*	0.40*	0.41*	0.42*	39.9*	0.45*	0.45*	0.49*	45.4*	0.35*	0.38*	0.39*
10-14 years	50.8*	0.55*	0.59*	0.61*	43.4*	0.52*	0.59*	0.64*	57.6*	0.57*	0.59*	0.61*
15-19 years	55.0*	0.65*	0.60*	0.61*	48.5*	0.64*	0.60*	0.63*	61.5*	0.67*	0.62*	0.62*
20-29 years	65.2*	1.00	0.82*	0.83*	58.5*	0.95	0.77*	0.82*	71.7*	1.06	0.87	0.88
30+ years	78.2*	1.91*	1.00	0.99	73.5*	1.87*	0.99	0.96	82.7*	2.01*	1.05	1.07
Canadian-born ^{¶¶}	65.2	1.00	1.00	1.00	59.7	1.00	1.00	1.00	70.4	1.00	1.00	1.00
Heart disease												
All immigrants	5.4*	1.10*	0.85*	0.88*	5.6	1.06	0.79*	0.81*	5.1*	1.14*	0.90	0.92
0-9 years	1.8* ^{E1}	0.36*	0.66*	0.90	1.4* ^{E1}	0.26*	0.44*	0.67	2.2* ^{E1}	0.48*	0.92	1.13
10-19 years	2.3*	0.45*	0.59*	0.60*	1.5* ^{E1}	0.27*	0.39*	0.41*	3.0* ^{E1}	0.67*	0.82	0.78
20-29 years	4.1	0.84	0.90	0.84	5.2* ^{E1}	0.97	1.03	1.02	3.2* ^{E1}	0.69	0.73	0.63
30+ years	11.0*	2.41*	0.95	0.94	12.2*	2.47*	0.89	0.86	9.9*	2.34*	0.96	0.98
Canadian-born ^{¶¶}	4.9	1.00	1.00	1.00	5.3	1.00	1.00	1.00	4.5	1.00	1.00	1.00
Diabetes												
All immigrants	5.0*	1.29*	1.00	1.06	5.2*	1.25*	0.93	0.98	4.8*	1.34*	1.04	1.11
0-9 years	1.4*	0.36*	0.50*	0.67*	1.6* ^{E1}	0.37*	0.56*	0.74	1.3* ^{E1}	0.34*	0.41*	0.57
10-19 years	3.1	0.80	0.94	1.02	2.8* ^{E1}	0.67	0.90	0.90	3.4* ^{E1}	0.94	0.99	1.11
20-29 years	5.8*	1.53*	1.47*	1.56*	6.0* ^{E1}	1.47*	1.40	1.51*	5.7	1.60*	1.52*	1.55*
30+ years	8.7*	2.36*	1.04	1.03	9.4*	2.37*	0.93	0.92	8.1*	2.35*	1.13	1.12
Canadian-born ^{¶¶}	3.9	1.00	1.00	1.00	4.2	1.00	1.00	1.00	3.6	1.00	1.00	1.00
High blood pressure												
All immigrants	15.2*	1.31*	1.01	1.05	13.8*	1.33*	1.01	1.07	16.5*	1.30*	1.01	1.04
0-9 years	5.9*	0.46*	0.76*	0.90	5.6*	0.49*	0.78	0.93	6.2*	0.43*	0.75*	0.88
10-19 years	8.5*	0.68*	0.86	0.98	7.4*	0.66*	0.93	1.06	9.5*	0.69*	0.77	0.91
20-29 years	15.6*	1.36*	1.31*	1.37*	15.8*	1.56*	1.41*	1.55*	15.4	1.20	1.21	1.20
30+ years	27.2*	2.74*	1.04	1.02	24.2*	2.64*	0.99	0.98	30.2*	2.85*	1.10	1.07
Canadian-born ^{¶¶}	12.0	1.00	1.00	1.00	10.8	1.00	1.00	1.00	13.2	1.00	1.00	1.00
Cancer												
All immigrants	1.9	1.13	0.92	0.92	2.1*	1.31*	0.98	0.98	1.8	0.98	0.87	0.86
0-9 years	0.5* ^{E2}	0.31*	0.56	0.59	-- ^F	0.52	1.03	1.19	-- ^F	0.13*	0.21*	0.27*
10-19 years	0.9* ^{E2}	0.52*	0.74	0.64	-- ^F	0.72	1.26	1.32	0.7* ^{E2}	0.35*	0.45*	0.26*
20-29 years	0.8* ^{E2}	0.49*	0.42*	0.49*	-- ^F	0.19*	0.15*	0.18*	1.4* ^{E2}	0.74	0.67	0.75
30+ years	4.3*	2.60*	1.19	1.16	4.6*	2.99*	1.10	1.07	4.1*	2.27*	1.27	1.22
Canadian-born ^{¶¶}	1.7	1.00	1.00	1.00	1.6	1.00	1.00	1.00	1.8	1.00	1.00	1.00

Data source: 2000/01 Canadian Community Health Survey

† Prevalence estimates expressed as percentages. Estimates exclude records with missing values for the dependent variable.

‡ Unadjusted odds ratios.

§ Odds ratios adjusted for age, education, and household income.

¶¶ Odds ratios adjusted for age, education, household income, smoking, heavy drinking, overweight or obesity, physical inactivity, and fruit and vegetable consumption.

‡‡ Reference category

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

E1 Coefficient of variation between 16.6% and 25.0%.

E2 Coefficient of variation between 25.1% and 33.3%.

F Coefficient of variation greater than 33.3%, estimate suppressed.

Definitions

Respondents were asked to name the country in which they were born. Those who specified a country other than Canada were asked if they had been born a Canadian citizen. If not, they were asked what year they first came to live in Canada. On the basis of responses to these questions, immigrant respondents were categorized by *length of residence* in Canada (0-4, 5-9, 10-14, 15-19, 20-29, 30+ years). The first four categories were collapsed into two categories for the analysis of specific chronic conditions.

Age in years was treated as a continuous variable.

Respondents were grouped into four categories on the basis of the highest level of *education* attained as of the completion of the first cycle of the CCHS: less than secondary school graduation, secondary school graduation, some post-secondary education, and post-secondary degree or diploma.

Household income groups were based on household size, as follows:

Household income group	People in household	Total household income
Lowest	1 to 4 5 or more	Less than \$10,000 Less than \$15,000
Lower-middle	1 or 2 3 or 4 5 or more	\$10,000 to \$14,999 \$10,000 to \$19,999 \$15,000 to \$29,999
Middle	1 or 2 3 or 4 5 or more	\$15,000 to \$29,999 \$20,000 to \$39,999 \$30,000 to \$59,999
Upper-middle	1 or 2 3 or 4 5 or more	\$30,000 to \$59,999 \$40,000 to \$79,999 \$60,000 to \$79,999
Highest	1 or 2 3 or more	\$60,000 or more \$80,000 or more

Respondents were asked if they had any long-term conditions that had lasted or were expected to last 6 months or more and that had been diagnosed by a health professional. The presence of *chronic conditions* was defined as a reported diagnosis of at least one of the following conditions: food allergies, other allergies, asthma, fibromyalgia, arthritis or rheumatism, back problems, high blood pressure, migraine headaches, chronic bronchitis, chronic obstructive pulmonary disease, diabetes, epilepsy, heart disease, cancer, stomach or intestinal ulcers, effects of a stroke, urinary incontinence, Crohn's disease or colitis, Alzheimer's disease or any other dementia, cataracts, glaucoma, a thyroid condition, Parkinson's disease, multiple sclerosis, chronic fatigue syndrome, multiple chemical sensitivities, or any other long-term condition that had been diagnosed by a health professional.

Occurrence of four specific chronic conditions, *heart disease*, *diabetes*, *high blood pressure*, and *cancer*, was determined from the relevant responses to the question above.

Smokers were identified by asking individuals if they smoked cigarettes daily, occasionally, or not at all. Smokers include daily and occasional smokers.

Body mass index (BMI) is calculated by dividing reported weight in kilograms by the square of reported height in metres. In this analysis, people with a BMI of 25 or more were classified as *overweight* or *obese*, which follows World Health Organization (WHO) standards. BMI was not calculated for pregnant respondents.

Respondents were asked a series of questions about alcohol consumption. Those who reported having had at least one drink in the past 12 months were asked if they had had any drinks over the past week. If so, they were asked how many drinks they had consumed on each day of the past week. *Heavy drinkers* were those who reported an average of more than 2 drinks per day (rounded off to the nearest unit) over the past week.

Level of physical activity was based on total energy expenditure during leisure time. Values for energy expenditure were calculated from information on the frequency and average duration of respondents' reported leisure-time activities in the previous 3 months, as well as the metabolic energy demand of each of those activities. Respondents were defined as being *physically inactive at leisure* if they expended less than 1.5 kcal/kg daily.

The *frequency of fruit and vegetable consumption* was assessed by means of the following questions: "The next questions are about the foods you usually eat or drink. Think about all the foods you eat, both meals and snacks, at home and away from home.

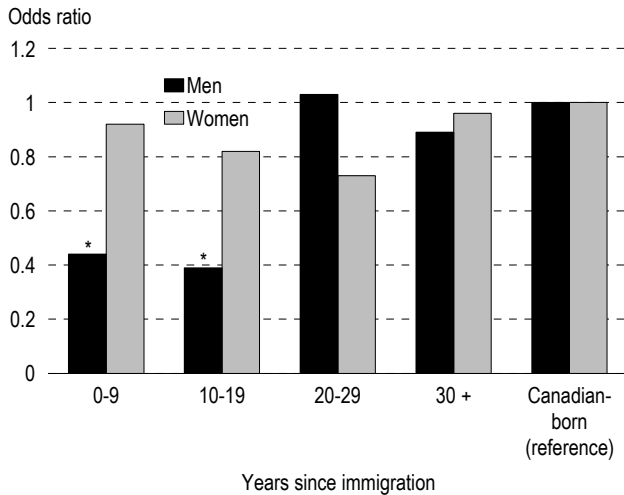
- (1) How often do you usually drink fruit juices such as orange, grapefruit, or tomato? (for example, once a day, three times a week, twice a month)
- (2) Not counting juice, how often do you usually eat fruit?
- (3) How often do you (usually) eat green salad?
- (4) How often do you usually eat potatoes, not including French fries, fried potatoes, or potato chips?
- (5) How often do you (usually) eat carrots?
- (6) Not counting carrots, potatoes, or salad, how many servings of other vegetables do you usually eat?"

Because the data were skewed, total frequency of daily fruit and vegetable consumption was transformed by means of the log value to yield a final consumption *index* (zero values were given the next-lowest value, 0.005, before the log was calculated).

Respondents were also categorized by the following seven *places of origin*: Canada (non-immigrants), other North America (United States and Mexico), Europe, Africa, South and Central America (including the Caribbean), Asia, and Australia (including all of Oceania). The last two categories were collapsed for the purposes of analysis.

The exact wording and order of the questions may be obtained from CCHS documentation.

Chart 2
Odds ratios for heart disease, by sex and years since immigration, adjusted for age, education, and income



Data source: 2000/01 Canadian Community Health Survey
* Significantly different from the reference category ($p < 0.05$).

Only recently arrived men had lower odds of heart disease

For heart disease, unlike the situation for chronic conditions in general, the health advantage of immigrants as a whole over the Canadian-born population was apparent only after adjustment for age, education, and household income. When immigrants are broken down into smaller groups, however, this health advantage is observed only among immigrant men, specifically those who resided in Canada less than 20 years. Men who had immigrated to this country earlier were comparable to men born in Canada. By contrast, immigrant women exhibited no such advantage, regardless of time since immigration.

Immigrants and non-immigrants were similar in terms of diabetes, high blood pressure, and cancer

For the three other specific conditions that were studied, there appeared to be no overall advantage for either male or female immigrants over non-immigrants. In fact, immigrant men and women overall fared worse than other Canadians by these measures before adjustment for the selected socio-demographic characteristics (the exception being that immigrant and non-immigrant women had comparable odds of a diagnosis of cancer). But after adjustment for age, education, and income, the odds of reporting these conditions were similar for immigrants and the Canadian-born population.

Accounting for socio-demographic factors

Tables 1 and 2 and Appendix Table B show both unadjusted results and results adjusted for age, education, and income. The unadjusted results provide an overall picture of the health of immigrants and non-immigrants. However, the age structure of these groups varies significantly, new immigrants being much younger and those who have resided in Canada for decades being considerably older than the overall population.⁷ Immigrants are also heterogeneous in terms of socio-economic status. Longer-term residents are better established than newer immigrants, which is reflected in their education and household income.⁷ But even among immigrants with comparable length of residence in Canada, there exists wide variation in education and income. "Independent" immigrants, including skilled workers and business people, are selected for their potential economic contribution to the country and tend to have relatively high levels of education and income. "Family class" immigrants are sponsored by Canadian citizens or residents and include spouses, dependent children, and parents. "Refugees" are people who have been admitted for humanitarian reasons.² The latter group, which accounted for 13% of all immigrants in 1999,² is the most economically disadvantaged and is in the worst health.¹⁴

Given the well-established link between health status and education, income, and (especially) age, results that do not take these factors into account may be misleading; therefore, the discussion in this paper focuses on the adjusted results.

Again with the exception of cancer among women, there was no clear gradient of higher adjusted odds of reporting these conditions with increasing time since immigration. In fact, the female immigrant cohort with the highest adjusted odds for a diagnosis of diabetes, relative to non-immigrants, was that which arrived in Canada between 20 and 29 years ago. The same is true for immigrant men and high blood pressure. Paradoxically, that same male cohort was the only one to have significantly lower adjusted odds than Canadian-born men of having a cancer diagnosis. It must be noted that cancer is of particularly low prevalence in some of these groups, which may lead to relatively unstable odds ratio estimates. Thus, among women, although the adjusted odds of reporting cancer increased with time since

immigration, and the immigrant cohort that had spent 30 or more years in Canada had elevated odds of such a diagnosis (1.27), this estimate did not achieve statistical significance.

Immigrants exhibited mixed patterns of health behaviours

From the time that immigrants arrive in Canada, they undergo an acculturation process by which ideas and behaviours associated with their place of origin are replaced by Canadian ideas and behaviours. Lifestyle behaviours related to health may change over time as a result of this acculturation, coming to more closely resemble the behaviours of Canadians in general. This section examines patterns in health behaviours among immigrants with different lengths of time since immigration and compares them with those of Canadian-born respondents.

Smoking was consistently less prevalent among immigrants than among their Canadian-born counterparts (Table 2). This was especially true for immigrant women - the odds ratios (adjusted for age, education, and income) for reporting smoking ranged from 0.20 for the most recent arrivals to 0.61 for the earliest arrivals. Among men, the gap between immigrants and non-immigrants was smaller, but the adjusted odds ratios for smoking never surpassed 0.75, the estimate for men who had spent 20 to 29 years in Canada.

In terms of overweight and obesity, the situation also differed between men and women. The prevalence of body mass index (BMI) of at least 25 was higher among men than among women. However, after controlling for socio-demographic factors, all immigrant men had healthier BMI profiles than Canadian-born men. For women, this advantage applied only to recent arrivals, that is, those who arrived in Canada less than 10 years ago.

Heavy drinking, defined as consuming an average of more than 2 drinks daily in the week before being interviewed for the CCHS, was rare, at least as measured by these self-reported data. For women in particular, and especially immigrant women, the prevalence of heavy drinking was low. Both male and female immigrants displayed significantly lower adjusted odds of heavy drinking, except women who had lived in Canada 30 or more years, for whom odds were comparable to those for women born in Canada.

Physical inactivity at leisure time differed from the other health behaviours studied, in that the Canadian-born population displayed a healthier pattern than their immigrant counterparts. Furthermore, there appeared to be no clear pattern of convergence between the

two groups with time since immigration (although immigrant men who had been in Canada the longest had lower adjusted odds of reporting physical inactivity than Canadian-born respondents).

Immigrants as a whole consumed fruits and vegetables more frequently than non-immigrants, and there was little evidence of acculturation-driven convergence. However, some immigrant cohorts reported fruit and vegetable consumption patterns that were similar to those of their Canadian-born counterparts (specifically men with 20 to 29 years since immigration and women with 15 to 29 years since immigration).

Health behaviours explained few health differences

Given the mixed patterns in health behaviours among immigrants relative to non-immigrants, it is perhaps not surprising that these behaviours played a weak role in explaining differences in health outcomes, above and beyond differences in socio-demographic characteristics. That is, the majority of differences and similarities in health outcomes between immigrants and non-immigrants that were observed when controlling for age, education and income remained after further adjustment for health behaviours. For example, in the case of chronic conditions in general, differences between immigrants and non-immigrants were generally attenuated after further controlling for health behaviours (Table 1). However, the changes were modest and no significant differences disappeared.

In terms of specific chronic conditions, there were few sex-specific cases where significant differences between immigrants and Canadian-born respondents vanished with further adjustment for health behaviours. In terms of heart disease and diabetes among men and diabetes and high blood pressure among women, the health advantage of the most recent immigrants (living less than 10 years in Canada) over non-immigrants disappeared. However, in the case of diabetes in particular, it appears that the loss of statistical significance is at least in part due to lack of statistical power (diabetes results for men and women combined did not show a loss of significance).

Convergence of health

The specific chronic conditions analyzed here did not display a clear gradient of increasing adjusted odds ratios with time since immigration, as was the case with chronic conditions in general. This lack of gradient is illustrated well by the example of cancer among men; the odds ratios for reporting such a diagnosis

Table 2
Prevalence of and odds ratios for selected health behaviours and means for frequency of fruit and vegetable consumption index, by sex and years since immigration, household population aged 12 or older, Canada, 2000/01

Health behaviour by years since immigration	All respondents			Men			Women		
	Prevalence (%) [†]	Unadjusted odds ratio [‡]	Adjusted odds ratio [§]	Prevalence (%) [†]	Unadjusted odds ratio [‡]	Adjusted odds ratio [§]	Prevalence (%) [†]	Unadjusted odds ratio [‡]	Adjusted odds ratio [§]
Smoker									
All immigrants	16.6*	0.50*	0.50*	21.3*	0.63*	0.64*	12.0*	0.37*	0.36*
0-4 years	15.5*	0.46*	0.36*	21.1*	0.62*	0.52*	9.5*	0.28*	0.20*
5-9 years	15.6*	0.47*	0.38*	21.7*	0.65*	0.53*	9.7*	0.29*	0.23*
10-14 years	16.5*	0.50*	0.44*	23.2*	0.70*	0.66*	10.3*	0.31*	0.25*
15-19 years	20.1*	0.63*	0.60*	25.2*	0.79*	0.73*	15.1*	0.48*	0.47*
20-29 years	17.0*	0.52*	0.55*	23.1*	0.70*	0.75*	11.2*	0.34*	0.36*
30+ years	16.5*	0.50*	0.64*	18.5*	0.53*	0.67*	14.5*	0.46*	0.61*
Canadian-born ^{##}	28.5	1.00	1.00	30.0	1.00	1.00	27.0	1.00	1.00
Overweight or obese									
All immigrants	42.5*	0.89*	0.77*	46.6*	0.81*	0.67*	38.1	0.99	0.86*
0-4 years	28.3*	0.48*	0.55*	33.1*	0.46*	0.52*	21.9*	0.45*	0.52*
5-9 years	27.2*	0.45*	0.51*	29.7*	0.39*	0.43*	24.5*	0.52*	0.59*
10-14 years	37.6*	0.73*	0.81*	41.8*	0.67*	0.74*	33.3	0.80*	0.87
15-19 years	42.0	0.88	0.81*	47.5	0.84	0.69*	36.2	0.91	0.90
20-29 years	45.9	1.03	0.86*	50.6	0.95	0.75*	41.0	1.11	0.97
30+ years	54.7*	1.46*	0.92	59.4*	1.36*	0.79*	49.9*	1.59*	1.04
Canadian-born ^{##}	45.3	1.00	1.00	51.8	1.00	1.00	38.5	1.00	1.00
Heavy drinker									
All immigrants	1.5*	0.40*	0.44*	2.7*	0.40*	0.42*	0.3 ^{*E2}	0.35*	0.36*
0-4 years	-- ^F	0.11*	0.13*	-- ^F	0.10*	0.11*	-- ^F	0.17*	0.17*
5-9 years	-- ^F	0.19*	0.21*	-- ^F	0.19*	0.21*	-- ^F	0.12*	0.12*
10-14 years	1.2 ^{*E2}	0.31*	0.34*	2.2 ^{*E2}	0.32*	0.36*	-- ^F	0.17 ^{*§§}	0.13 ^{*§§}
15-19 years	1.5 ^{*E2}	0.41*	0.38*	3.2 ^{*E2}	0.47*	0.42*	-- ^F	0.17*	0.20*
20-29 years	1.9 ^{*E1}	0.51*	0.54*	3.7 ^{*E1}	0.56*	0.58*	-- ^F	0.17*	0.20*
30+ years	2.2*	0.59*	0.70*	3.7*	0.56*	0.62*	0.7 ^{E2}	0.75	1.08
Canadian-born ^{##}	3.7	1.00	1.00	6.5	1.00	1.00	1.0	1.00	1.00
Physically inactive									
All immigrants	60.8*	1.46*	1.33*	57.7*	1.51*	1.35*	63.7*	1.42*	1.32*
0-4 years	60.2*	1.42*	1.53*	57.1*	1.47*	1.53*	63.6*	1.41*	1.58*
5-9 years	63.8*	1.65*	1.67*	61.0*	1.72*	1.75*	66.3*	1.59*	1.61*
10-14 years	63.7*	1.64*	1.78*	61.0*	1.73*	1.84*	66.1*	1.58*	1.74*
15-19 years	65.0*	1.74*	1.81*	60.5*	1.69*	1.71*	69.1*	1.81*	1.95*
20-29 years	63.8*	1.65*	1.58*	64.8*	2.03*	1.93*	62.8*	1.36*	1.30*
30+ years	56.3*	1.21*	0.85*	51.2*	1.16*	0.80*	61.1*	1.27*	0.91
Canadian-born ^{##}	51.6	1.00	1.00	47.5	1.00	1.00	55.3	1.00	1.00
		Unadjusted mean	Adjusted mean^{††}		Unadjusted mean	Adjusted mean^{††}		Unadjusted mean	Adjusted mean^{††}
Fruit and vegetable consumption index									
All immigrants		1.44*	1.21*		1.39*	1.13*		1.49*	1.24*
0-4 years		1.42*	1.24*		1.40*	1.20*		1.45	1.25*
5-9 years		1.42*	1.23*		1.38*	1.17*		1.45	1.24*
10-14 years		1.40	1.19*		1.31	1.08*		1.49	1.25*
15-19 years		1.42*	1.19*		1.39*	1.14*		1.44	1.18
20-29 years		1.42*	1.17		1.34*	1.06		1.50*	1.22
30+ years		1.49*	1.21*		1.44*	1.14*		1.54*	1.24*
Canadian-born ^{##}		1.38	1.14		1.30	1.03		1.46	1.20

Data source: 2000/01 Canadian Community Health Survey

[†] Prevalence estimates expressed as percentages. Estimates exclude records with missing data for the dependent variable.

[‡] Unadjusted odds ratios.

[§] Odds ratio, adjusted for age, education, and household income.

^{††} Mean adjusted for age, education, and household income.

^{##} Reference category

^{§§} Categories "10-14 years" and "15-19 years" have been collapsed.

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

E1 Coefficient of variation between 16.6% and 25.0%.

E2 Coefficient of variation between 25.1% and 33.3%.

F Coefficient of variation greater than 33.3%, estimate suppressed.

What about place of origin?

Health differences observed among immigrant groups may be due in part to a cohort effect, which may, in turn, be partially due to differences in place of origin. In fact, patterns in place of origin of immigrants can vary drastically from year to year, which might reflect differences in both population health and the health care systems of their countries of birth. Immigrants with longer-term residence in Canada are more likely to be of European origin, whereas nearly half of all immigrants now coming to Canada originate from Asia. Variations in mortality rates have also been observed for different ethnic populations¹⁶. It would not be unreasonable, then, for differences in place of origin to partially explain differences in health profiles across immigrant groups defined by time since immigration to Canada.

Performing the analysis again, but restricting it to the immigrant community only, allowed for the exploration of place of origin as a potential explanation for the presence of selected chronic conditions, while also accounting for the various socio-demographic and lifestyle factors considered elsewhere in this study. With immigrants who moved to Canada 30 or more years ago as the reference group, the data predictably showed a gradient of increasing odds of reporting any chronic condition with length of residence in Canada (Appendix Table B), much as was previously observed in analyses of immigrants with non-immigrants as the reference group. Once age, education, household income, smoking, heavy drinking, overweight or obesity, physical inactivity, and fruit and vegetable consumption were accounted for, the differences between immigrant groups declined substantially. For example, compared with immigrants who had lived in Canada for 30 years or more, the odds ratio among recent arrivals for reporting any chronic condition changed from 0.17 before to 0.42 after adjustment. However, the gradient remained, with the four most recent immigrant groups displaying significantly lower odds of reporting some chronic conditions in general than immigrants with the longest residency in Canada.

Adjusting for place of origin in addition to the factors changed the odds ratios again, but not as dramatically. Furthermore, sex-specific changes in significance occurred in rare cases. The differences in odds of reporting chronic conditions in general between immigrant women who had been in Canada between 10 and 19 years and non-immigrant women changed from approximately 0.67 to 0.76, after accounting for place of origin. Likewise, the odds ratio for reporting high blood pressure among immigrant men with 20 to 29 years of residence in Canada dropped from 1.50 to 1.33 after a similar adjustment. In cases where there existed significant differences between the newest and earliest immigrant cohorts, place of origin did not explain these differences.

were actually lowest among men who had resided in Canada between 20 and 29 years. Perhaps this is partially because these conditions are relatively rare, compared with chronic diseases in general and especially rare among newer immigrants. In all cases, however, immigrants who had resided in Canada 30 years or more had similar adjusted odds of reporting these conditions to those of their Canadian-born counterparts.

Nonetheless, the convergence in health status between immigrants and non-immigrants for chronic conditions in general should be interpreted with caution. Cross-sectional data cannot indicate if the health status of immigrants is truly deteriorating with increasing length of residence in Canada (relative to non-immigrants). Some of the differences among immigrant sub-groups may result from a cohort effect, whereby, for example, immigrants who had been in Canada for less than 5 years in 2000/01 simply had a better health profile when they entered the country than did other immigrants at their respective times of arrival. Possible reasons for such differences might be evolving immigration criteria and increasing competition to enter the country.

Another potential explanation for convergence of health status between immigrants and non-immigrants, in terms of chronic conditions in general, is that, after some time spent living in Canada, the healthiest immigrants emigrate again, at rates higher than the emigration rate for the healthy Canadian-born population. Such emigration would leave a comparatively sicker immigrant population. Some evidence exists to support this hypothesis. A current study that focuses on immigrants who obtained landed immigrant status in the 1980s has discovered that the most highly skilled immigrants and their dependents are those most likely to emigrate,¹⁷ and it is precisely this group that is healthiest.¹⁴

Concluding remarks

With adjustment for socio-demographic factors, the findings for chronic conditions in general revealed a remarkable gradient of worsening immigrant health with increasing time since immigration. Moreover, immigrants who had been in Canada the longest had outcomes similar to those of their Canadian-born counterparts. The results were not as consistent for specific chronic conditions, perhaps in part because such outcomes were rarer. Immigrants' patterns of health-related lifestyle behaviours varied with length of residence in Canada, but the results did not necessarily show that immigrants become more like other Canadians in this respect with increasing time

in Canada. After adjustment for socio-demographic differences, health behaviours did not generally explain differences in health between immigrant groups and the Canadian-born population.

The evidence that immigrants adopt poor health behaviours and that their health (as measured by the

selected chronic conditions) worsens with increasing time in Canada is weak. A longitudinal analysis in which immigrant respondents are followed over a period of time is needed to shed further light on these patterns.

References

- 1 Van Kessel GCJ. *The Canadian Immigration System*. Ottawa: Citizenship and Immigration Canada, 1998. Available at <http://www.coskuner.net/english.htm#canadian%20immigration%20system>. Accessed August 27, 2002.
- 2 Citizenship and Immigration Canada. *The Canadian Immigration System. Statistics at a Glance*. Ottawa: Public Works and Government Services Canada, 1998.
- 3 Kinnon D. *Canadian Research on Immigration and Health*. Ottawa: Health Canada, 1999.
- 4 Serdula M, Coates R, Byers T, et al. Evaluation of a brief telephone questionnaire to estimate fruit and vegetable consumption in diverse study populations. *Epidemiology* 1993, 4(5): 455-63.
- 5 Hyman I. *Immigration and Health* [working paper]. Ottawa: Health Canada, 2001. Available at <http://dsp-psd.comunication.gc.ca/Collection/H13-5-01-5E.pdf>. Accessed June 30, 2002.
- 6 Wilkins K. Tuberculosis 1994. *Health Reports* (Statistics Canada, Catalogue 82-003) 1996; 8(1): 33-9.
- 7 Chen J, Ng E, Wilkins R. The health of Canada's immigrants in 1994-95. *Health Reports* (Statistics Canada, Catalogue 82-003) 1996; 7(4): 33-45.
- 8 Chen J, Ng E, Wilkins R. Health expectancy by immigrant status. *Health Reports* (Statistics Canada, Catalogue 82-003). 1996; 8(3): 29-37.
- 9 Parakulam G, Krishnan V, Odynak D. Health status of Canadian-born and foreign-born residents. *Canadian Journal of Public Health* 1992; 83(4): 311-4.
- 10 Donovan JL, d'Espaignet E, Metron C, et al. *Immigrants in Australia: a health profile*. Canberra, Australia: Australian Government Publishing Service, 1992.
- 11 Stephen EH, Foote K, Hendershot GE, et al. Health of the foreign-born population. *Advance Data from Vital and Health Statistics* 1994; 241: 1-10.
- 12 Zambrana RE, Scrimshaw SCM, Collins N, et al. Prenatal health behaviors and psychosocial risk factors in pregnancy in women of Mexican origin: the role of acculturation. *American Journal of Public Health* 1997; 87(8): 1022-6.
- 13 Hull D. Migration, adaptation and illness. A review. *Social Science and Medicine* 1979; 13A: 25-36.
- 14 Kliever EV, Jones R. *Immigrant Health and the Use of Medical Services: Results from the Longitudinal Survey of Immigrants to Australia*. Canberra, Australia: Department of Immigration and Multicultural Affairs, 1997.
- 15 Laroche M. *Health Status and Health Services Utilization of Canada's Immigrant and Non-Immigrant Populations*. *Canadian Public Policy* 2000; 26(1): 51-73.
- 16 Sheth T, Nair C, Nargundkar M, et al. Cardiovascular and cancer mortality among Canadians of European, south Asian and Chinese origin from 1979 to 1993: an analysis of 1.2 million deaths. *Canadian Medical Association Journal* 1999, 161(2): 132-8.
- 17 Dryburgh HB, Kelly M. *Immigrant change: Using taxfiling patterns to identify patterns of emigration and mortality among landed immigrants* [working paper]. Ottawa: Statistics Canada, Housing, Family, and Social Statistics Division. In press.

Appendix

Table A
Distribution of selected characteristics, by sex, household population aged 12 or older, Canada, 2000/01

Variable	All respondents			Men			Women		
	Sample size	Estimated population ('000s)	%	Sample size	Estimated population ('000s)	%	Sample size	Estimated population ('000s)	%
Total	131,535	25,801.7	100.0	60,849	12,705.4	100.0	70,686	13,096.3	100.0
Years since immigration									
0-4 years	1,872	742.2	2.9	923	385.3	3.0	949	356.9	2.7
5-9 years	1,849	740.5	2.9	862	366.3	2.9	987	374.2	2.9
11-14 years	1,924	767.8	3.0	882	369.3	2.9	1,042	398.5	3.0
15-19 years	1,032	384.2	1.5	483	190.8	1.5	549	193.4	1.5
20-29 years	2,615	892.1	3.5	1,183	436.1	3.4	1,432	456.0	3.5
30+ years	7,609	1,755.5	6.8	3,509	870.5	6.9	4,100	885.0	6.8
Canadian-born	112,954	20,144.9	78.1	52,223	9,907.0	78.0	60,731	10,237.9	78.2
Missing	1,680	374.5	1.5	784	180.1	1.4	896	194.4	1.5
Education									
Less than secondary school graduation	44,571	7,551.8	29.3	21,159	3,760.7	29.6	23,412	3,791.1	28.9
Secondary school graduation	22,982	4,778.2	18.5	10,068	2,215.3	17.4	12,914	2,563.0	19.6
Some post-secondary education	9,859	2,108.5	8.2	4,338	1,013.7	8.0	5,521	1,094.8	8.4
Post-secondary degree	52,848	11,144.8	43.2	24,640	5,598.6	44.1	28,208	5,546.1	42.3
Missing	1,275	218.4	0.8	644	117.1	0.9	631	101.3	0.8
Household income									
Lowest	5,717	890.1	3.4	2,325	392.8	3.1	3,392	497.3	3.8
Lower-middle	12,117	1,778.3	6.9	3,875	669.7	5.3	8,242	1,108.6	8.5
Middle	28,829	5,141.6	19.9	12,521	2,386.1	18.8	16,308	2,755.5	21.0
Upper-middle	41,057	8,172.0	31.7	20,158	4,130.6	32.5	20,899	4,041.3	30.9
Highest	29,445	7,073.7	27.4	15,932	3,865.8	30.4	13,513	3,207.9	24.5
Missing	14,370	2,746.0	10.6	6,038	1,260.4	9.9	8,332	1,485.7	11.3
Chronic conditions									
Yes	87,573	16,468.2	63.8	36,929	7,421.9	58.4	50,644	9,046.3	69.1
No	43,727	9,291.6	36.0	23,789	5,258.4	41.4	19,938	4,033.2	30.8
Missing	235	42.0	0.2	131	25.2	0.2	104	16.8	0.1
Heart disease									
Yes	8,004	1,289.0	5.0	3,888	682.2	5.4	4,116	606.8	4.6
No	123,417	24,492.4	94.9	56,912	12,011.5	94.5	66,505	12,480.9	95.3
Missing	114	20.3	0.1	49	11.7	0.1	65	8.7	0.1
Diabetes									
Yes	6,361	1,063.7	4.1	3,104	556.8	4.4	3,257	506.9	3.9
No	125,087	24,719.2	95.8	57,707	12,138.2	95.5	67,380	12,581.0	96.1
Missing	87	18.8	0.1	38	10.3	0.1	49	8.5	0.1
High blood pressure									
Yes	19,371	3,257.2	12.6	7,764	1,443.3	11.4	11,607	1,813.9	13.9
No	111,916	22,497.7	87.2	52,944	11,233.0	88.4	58,972	11,264.6	86.0
Missing	248	46.9	0.2	141	29.1	0.2	107	17.8	0.1
Cancer									
Yes	2,713	450.3	1.7	1,192	211.3	1.7	1,521	239.0	1.8
No	128,720	25,335.2	98.2	59,613	12,485.3	98.3	69,107	12,849.8	98.1
Missing	102	16.2	0.1	44	8.8	0.1	58	7.5	0.1
Smoker									
Yes	35,844	6,677.9	25.9	17,823	3,562.6	28.0	18,021	3,115.2	23.8
No	95,339	19,052.5	73.8	42,810	9,094.4	71.6	52,529	9,958.2	76.0
Missing	352	71.3	0.3	216	48.4	0.4	136	22.9	0.2
Overweight or obese									
Yes	59,302	11,017.9	42.7	32,138	6,381.5	50.2	27,164	4,636.5	35.4
No	66,691	13,676.4	53.0	28,105	6,213.4	48.9	38,586	7,463.0	57.0
Missing	5,542	1,107.4	4.3	606	110.5	0.9	4,936	996.8	7.6
Heavy drinker									
Yes	4,103	815.7	3.2	3,463	706.4	5.6	640	109.3	0.8
No	125,472	24,617.6	95.4	56,147	11,759.6	92.6	69,325	12,858.1	98.2
Missing	1,960	368.4	1.4	1,239	239.4	1.9	721	129.0	1.0
Physically inactive									
Yes	64,413	12,661.7	49.1	26,784	5,611.5	44.2	37,629	7,050.2	53.8
No	58,645	11,000.2	42.6	28,214	5,685.8	44.8	30,431	5,314.3	40.6
Missing	8,477	2,139.8	8.3	5,851	1,408.0	11.1	2,626	731.8	5.6
Place of origin									
North America (excluding Canada)	1,642	301.2	1.2	683	136.4	1.1	959	164.8	1.3
South or Central America or Caribbean	1,309	588.8	2.3	571	264.3	2.1	738	324.5	2.5
Europe	9,333	2,337.9	9.1	4,308	1,156.0	9.1	5,025	1,181.9	9.0
Africa	746	289.2	1.1	383	163.7	1.3	363	125.5	1.0
Asia or Australia (including Oceania)	4,711	1,960.7	7.6	2,265	989.9	7.8	2,446	970.8	7.4
Canada	112,954	20,144.9	78.1	52,223	9,907.0	78.0	60,731	10,237.9	78.2
Missing	840	179.1	0.7	416	88.1	0.7	424	91.0	0.7

Data source: 2000/01 Canadian Community Health Survey

Table B
Odds ratios for selected health outcomes, by sex and length of residence in Canada, immigrant household population aged 12 or older, Canada, 2000/01

Condition by years since immigration	All respondents			Men			Women		
	Unadjusted odds ratio [†]	Adjusted odds ratio [‡]	Adjusted odds ratio [§]	Unadjusted odds ratio [†]	Adjusted odds ratio [‡]	Adjusted odds ratio [§]	Unadjusted odds ratio [†]	Adjusted odds ratio [‡]	Adjusted odds ratio [§]
All chronic conditions									
0-4 years	0.17*	0.42*	0.45*	0.18*	0.42*	0.42*	0.15*	0.45*	0.49*
5-9 years	0.21*	0.50*	0.54*	0.24*	0.59*	0.60*	0.17*	0.43*	0.49*
10-14 years	0.29*	0.71*	0.78*	0.28*	0.77	0.79	0.28*	0.67*	0.76
15-19 years	0.34*	0.70*	0.76*	0.34*	0.74	0.75	0.33*	0.68*	0.76
20-29 years	0.52*	0.92	0.98	0.51*	0.95	0.95	0.53*	0.91	0.99
30+ years ^{††}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Heart disease									
0-9 years	0.15*	0.91	1.07	0.10*	0.65	0.70	0.21*	1.24	1.63
10-19 years	0.19*	0.61*	0.72	0.11*	0.42*	0.46*	0.29*	0.84	1.12
20-29 years	0.35*	0.84	0.99	0.39*	1.07	1.18	0.30*	0.65	0.82
30+ years ^{††}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Diabetes									
0-9 years	0.15*	0.68	0.45*	0.15*	0.62	0.42*	0.15*	0.73	0.47
10-19 years	0.34*	1.02	0.67	0.28*	0.79	0.54	0.40*	1.29	0.82
20-29 years	0.65*	1.54*	1.05	0.62*	1.43	0.99	0.68*	1.63	1.10
30+ years ^{††}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
High blood pressure									
0-9 years	0.17*	0.87	0.78	0.19*	0.88	0.79	0.15*	0.85	0.75
10-19 years	0.25*	0.96	0.85	0.25*	1.01	0.91	0.24*	0.90	0.78
20-29 years	0.49*	1.33*	1.20	0.59*	1.50*	1.33	0.42*	1.15	1.05
30+ years ^{††}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Cancer									
0-9 years	0.12*	0.40*	0.43*	0.17*	0.74	0.94	0.06*	0.20*	0.17*
10-19 years	0.20*	0.47*	0.53	0.24*	0.89	1.21	0.15*	0.19*	0.18*
20-29 years	0.19*	0.37*	0.42*	0.06*	0.14*	0.18*	0.33*	0.57	0.54
30+ years ^{††}	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Data source: 2000/01 Canadian Community Health Survey

[†] Unadjusted odds ratios.

[‡] Odds ratios adjusted for age, education, household income, smoking, heavy drinking, overweight or obesity, physical inactivity, and fruit and vegetable consumption.

[§] Odds ratios adjusted for age, education, household income, smoking, heavy drinking, overweight or obesity, physical inactivity, fruit and vegetable consumption, and place of origin.

^{††} Reference category

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

Annex

Many analyses presented in this Health Reports Supplement are based on Statistics Canada's Canadian Community Health Survey (CCHS). Data collection for cycle 1.1 of the CCHS 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.

Cycle 1.1 of CCHS was designed to collect information at the health region level.¹ For administrative purposes, each province is divided into health regions (HR); each territory is designated as a single HR. When cycle 1.1 of the CCHS was designed, there were 139 health regions in Canada. The CCHS combines data collection for the Burntwood and Churchill health regions in Manitoba because of Churchill's small population. There are two remote health regions for which the CCHS does not collect data: the Région du Nunavik and the Région des Terres-Cries-de-la-Baie-James, both in Québec.

The CCHS uses the area frame designed for the Labour Force Survey as its primary sampling frame. A multistage stratified cluster design was used to

sample dwellings within the area frame. A list of the dwellings was prepared, and a sample of dwellings was selected from the list. The majority (83%) of the sampled households came from the area frame, and face-to-face interviews were held with respondents randomly selected from households in this frame. In some HRs, a random digit dialling (RDD) and/or list frame of telephone numbers was also used. Respondents in the telephone frames, who accounted for the remaining 17% of the targeted sample, were interviewed by telephone.

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

References

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