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Healthy today, healthy tomorrow? Findings from the National Population Health Survey

Dynamics of Immigrants' Health in Canada: Evidence from the National Population Health Survey

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Immigrants typically arrive in Canada with better-than-average health. In fact, many studies conducted in Canada and in the United States have established the existence of a so-called "healthy immigrant effect."¹⁻¹³ Because potential immigrants are screened on medical and other health-related criteria before they are admitted to the country, they are usually healthier than the Canadian-born population. There is also a degree of self-selection in the originating countries, with applicants likely to be individuals with the stamina and motivation to undertake the rigours that immigration entails.



Defining the immigrant population

Immigrants were defined as all persons who were not Canadian citizens by birth. Immigrants' origin is grouped into two broad categories according to their country of birth: European and non-European. As well as people born in Europe, the European category includes those born in United States, Australia and New Zealand. The non-European category refers to all other countries. This dichotomy is used to distinguish groups with cultural differences that might have an effect on health status and health needs. As well, since the 1960s, there has been a major shift toward non-European sources for immigrants to Canada.

Because of the heterogeneity of the immigrant populations, the European/non-European grouping is at best a crude way to capture the cultural differences underlying health transitions. It would have been preferable to categorize immigrants by region (for instance, South Asia, Eastern Europe, Western Europe, Latin America, Africa), but owing to sample size limitations, this was not possible. It would also have been desirable to compare refugees and other classes of immigrants. Refugees made up about 16% of all immigrants to Canada between 1980 and 1998.¹⁵ However, refugee status was not collected by the NPHS, although the Longitudinal Survey of Immigrants to Canada is a possible source of such data.¹⁴

Immigrants' actual duration of residence in Canada is not available from the National Population Health Survey (NPHS). The number of years between immigration and the first NPHS cycle (1994/95) was used as a proxy, but the duration of residence is not exact. Some people may have resided in Canada for several years before obtaining immigrant status, while others may have lived outside Canada for substantial periods after immigrating. Because of sample size limitations, just two duration categories were created: recent immigrants (10 years or less in 1994/95) and long-term immigrants (more than 10 years in 1994/95). Thus, for this analysis, recent immigrants are those who arrived in 1984 or later, and long-term immigrants are those who came before 1984.

For this analysis, four groups of immigrants are defined: recent non-European, long-term non-European, recent European, and long-term European.

Most studies of immigrant health have been based on data for a single point in time (cross-sectional data) and so have not been able to assess the health impact on immigrants as they settle in the host country. For example, an earlier article based on cross-sectional data

from 1994/95 showed immigrants, especially recent immigrants, to be healthier than the Canadian-born population, in that they were less likely to have chronic conditions or disabilities.¹ A study published in 2003 using the results of the first wave of the Longitudinal Survey of Immigrants to Canada had similar results: some six months after their arrival, 97% of immigrants rated their health as good, very good or excellent.¹⁴ This compared with 88% for the Canadian population overall. However, longitudinal data that result from tracking the same individuals over time are needed to determine if this health advantage lasts, and the factors that are associated with any change.¹³

This analysis attempts to disentangle the factors that contribute to the changes in immigrants' health after their arrival in Canada. It is based on five cycles of longitudinal data from Statistics Canada's National Population Health Survey (NPHS), which collected information from the same individuals over an eight-year period from 1994/95 to 2002/03 (see *Definitions and Methods*). This study compares patterns of change in health status, health care use, and health-related behaviours among immigrants with those of the Canadian-born population.

In 2001, Canada's 5.4 million immigrants made up 18.4% of the population, the highest percentage in 70 years. Canada now receives more than 200,000 immigrants each year, and they account for close to 60% of population growth. Without sufficient immigration to compensate for below-replacement fertility, the Canadian population would start to decline in about 30 years.¹⁶ A better understanding of the dynamics behind any changes in immigrants' health could inform public policy about potential risks that confront this increasingly important component of Canadian society (see *Defining the immigrant population*).



A period of adjustment

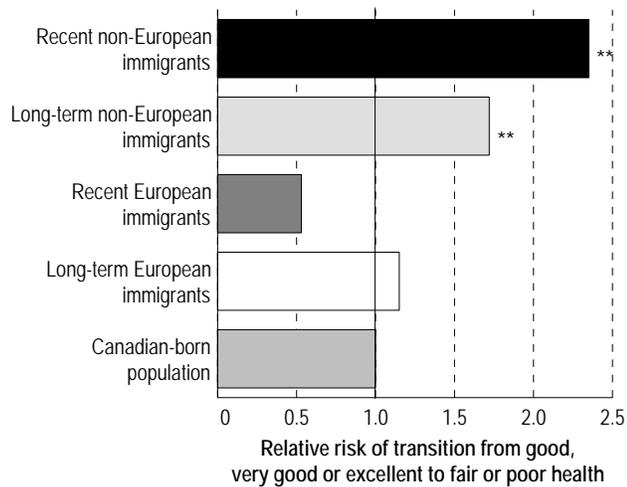
It has been hypothesized that with the passage of time, the health status of immigrants tends to converge toward that of the host population. In other words, the “healthy immigrant effect” diminishes over time. Some medical problems may arise as immigrants age like anyone else. Other problems may occur as immigrants are integrated and adopt behaviours that have negative health impacts. Other conditions may result from the process of immigration itself. Financial constraints, employment problems and the lack of a network of social support can each take a toll on well-being.

Self-perceived health is a commonly used indicator that has been shown to reflect other measures of health status such as mortality and clinically diagnosed morbidity.¹⁷ To study transitions in health status, an initially healthy population of NPHS respondents that included both immigrants and people born in Canada was examined. In 1994/95, they all rated their

health as good, very good or excellent. Data for the same people were analyzed over time to determine if there had been any changes in their self-perceived health.

An earlier longitudinal study using the first four cycles of the NPHS found that immigrants to Canada—European and non-European combined—were at higher risk of a deterioration in health than was the Canadian-born population.¹³ However, this new analysis of five cycles of NPHS data, which distinguishes between European and non-European immigrants, shows that the difference is attributable to those from non-European countries, who were twice as likely as the Canadian-born to report a deterioration in their health—that is, they had rated their health good, very good or excellent in 1994/95, but subsequently described themselves as being in fair or poor health (Chart 1, Appendix Table A). This decline was particularly pronounced among recent non-European

Chart 1
Non-European immigrants were more likely than the Canadian-born to report a deterioration in health

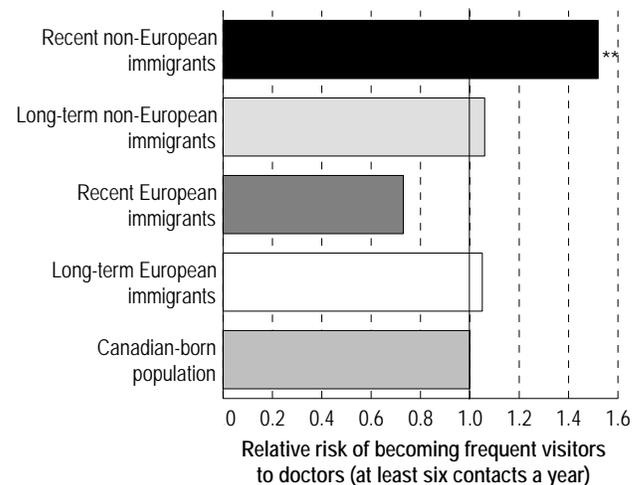


Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file.

Note: Analysis, based on individuals reporting good, very good or excellent health in 1994/95; controls for age, sex, income adequacy, education, smoking, inactive leisure, social support/social involvement and body mass index in 1994/95.

** Significantly different from estimate for Canadian-born ($p < 0.01$).

Chart 2
Recent non-European immigrants were more likely than the Canadian-born to become frequent visitors to doctors



Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file.

Note: Analysis, based on individuals reporting good, very good or excellent health in 1994/95; controls for age, sex, income adequacy and education in 1994/95.

** Significantly different from estimate for Canadian-born ($p < 0.01$).



immigrants. But surprisingly, even long-term non-European immigrants were more likely than the Canadian-born to report a shift toward fair or poor health.

Increasing frequency of doctor contacts

Is the decline in self-perceived health among recent non-European immigrants the result of changes in expectations as they integrate into Canadian society, or is it a real phenomenon? The results of the analysis of longitudinal data suggest the latter. Recent non-European immigrants' higher risk of reporting a deterioration in their health is mirrored in increasingly frequent doctor contacts. Over time, they were more likely than the Canadian-born to become frequent visitors to doctors (at least six contacts a year), suggesting that the health loss was not an artefact (Chart 2, Appendix Table B).

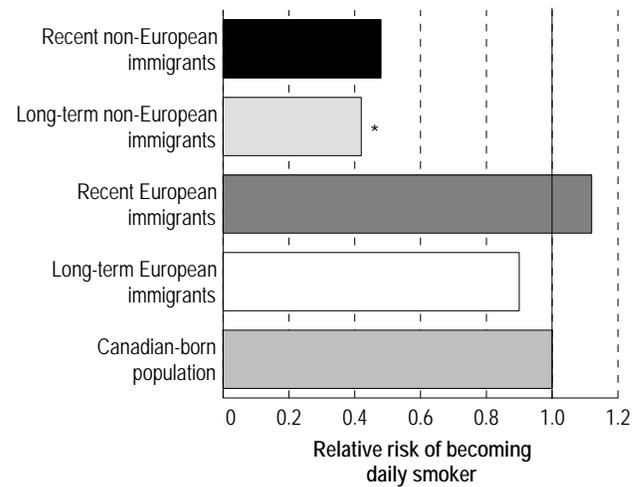
There was no statistically significant difference between any of the groups of immigrants selected for the study and the Canadian-born in the likelihood of being hospitalized. However, admission to hospital is usually necessitated by relatively serious health problems. It is possible that the eight years of follow-up available from the NPHS is not long enough for the decline in health to be severe enough to require hospitalization.

Lifestyle changes?

Immigrants' greater risk of reporting a decline in health might be attributable to a number of factors. For the population overall, daily smoking, inactive leisure time, and obesity were each found to be significantly associated with a deterioration in self-perceived health (Appendix Table A). Is it possible that in the process of adjusting to the Canadian lifestyle, non-European immigrants developed habits such as daily smoking^{18,19} that negatively affected their health?

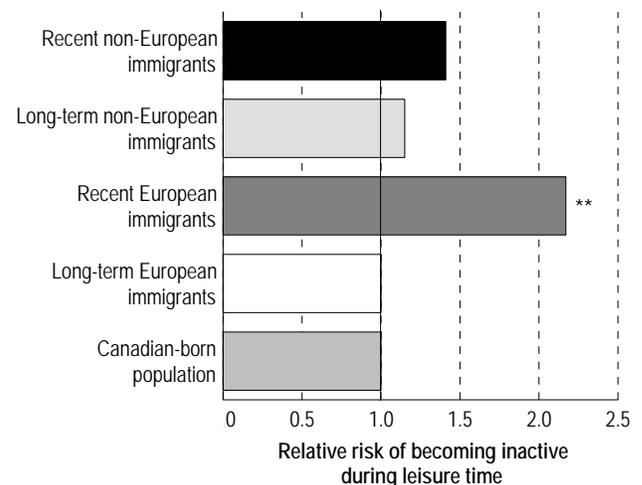
Yet over time, relatively few non-European immigrants became daily smokers (Chart 3, Appendix Table C). In fact, they were only half as likely as the Canadian-born population to

Chart 3
Non-European immigrants were less likely than the Canadian-born to become daily smokers



Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file.
 Note: Analysis, based on individuals reporting good, very good or excellent health in 1994/95; controls for age, sex, income adequacy and education in 1994/95.
 *Significantly different from estimate for Canadian-born ($p < 0.05$).

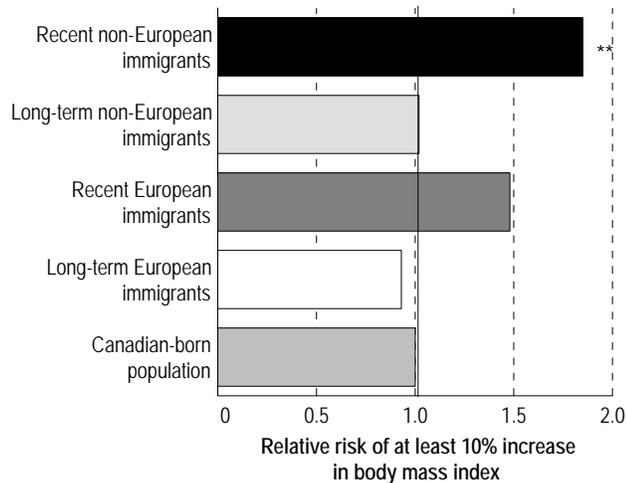
Chart 4
Recent European immigrants were more likely than the Canadian-born to become inactive in leisure time



Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file.
 Note: Analysis, based on individuals reporting good, very good or excellent health in 1994/95; controls for age, sex, income adequacy and education in 1994/95.
 **Significantly different from estimate for Canadian-born ($p < 0.01$).



Chart 5
Recent non-European immigrants were almost twice as likely as the Canadian-born to have a substantial weight gain



Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file.

Note: Analysis, based on individuals reporting good, very good or excellent health in 1994/95; controls for age, sex, income adequacy and education in 1994/95. Excludes people who were underweight in 1994/95.

** Significantly different from estimate for Canadian-born ($p < 0.01$).

do so. Therefore, initiation of daily smoking was unlikely to be associated with a greater risk of reporting a deterioration of their health over the eight years.

But while non-European immigrants were not adopting that bad habit, they were somewhat more likely than the Canadian-born to have become physically inactive during their leisure time (although the difference was not statistically significant) (Chart 4). If true, this could help explain these immigrants' greater risk of reporting a decline in self-perceived health. However, more evidence is needed to understand the complex associations between the level of leisure-time activity and health among immigrant groups. For example, the group most likely to become inactive were recent European immigrants. Yet paradoxically, in contrast to non-European immigrants, these recent European immigrants were not at a greater risk of reporting a deterioration of their health relative to the Canadian-born.

Although the decline in recent non-European immigrants' self-perceived health could not be directly linked to daily smoking or physical inactivity, weight gain was a possible contributor. Rapid changes within and between body mass index (BMI) categories could be considered as important indicators of potential problems.²⁰ Recent non-European immigrants were almost twice as likely as the Canadian-born population to have experienced at least a 10% increase in their BMI since 1994/95 (Chart 5).

Conclusion

Immigrants generally arrive with better health than the Canadian-born. However, as time passes, this "healthy immigrant effect" tends to diminish, as their health status converges with that of the host population. Some medical problems may arise as immigrants age, as well as when they are integrated and adopt behaviours that have negative health impacts. Other health problems may be due to the stress of immigration itself, which involves finding suitable employment and establishing a new social support network.

Longitudinal data from five cycles of the National Population Health Survey show that over the period 1994/95 to 2002/03, immigrants in general were more likely than the Canadian-born population to report a change from good, very good or excellent health to fair or poor health. However, this deterioration applied only to immigrants with non-European origins, especially those who had arrived since the mid-1980s. European immigrants, by contrast, were similar to the Canadian-born with regard to health transitions. A concomitant increase in the frequency with which recent non-European immigrants consulted physicians suggests that the loss of health was real, and not merely an artefact of cultural or subjective differences in the perception of health status.

Almost by definition, the process of immigration is stressful and disruptive, involving the loss of the support network of family and friends in the country of origin. But while lack



of social support was, indeed, a risk factor for a decline in health (Appendix Table A), it was not included in subsequent analysis of changes in risk factors (Appendix Table C) because the questions asked were identical only in the first two NPHS cycles. However, the data that are available show that in 1994/95, non-European immigrants were more likely than the Canadian-born population to report low social support.

The likelihood of a deterioration in health was also related to socio-economic status, specifically, low education and low household income (Appendix Table A). Findings from the literature on immigrants' economic integration in Canada have shown that those with non-European origins are more likely than those with European origins to have low-paid jobs that require little education.^{21,22} Because immigrants with European origins share a similar culture with the Canadian-born, they may encounter fewer social, economic and lifestyle barriers than do those from non-European countries.

The relationship between immigration and health transitions is highly complex,²³ involving not only socio-economic, cultural, behavioural, environmental and biological factors, but also pre-immigration history. Most of these variables are beyond the scope of this analysis. Nonetheless, data on lifestyle are somewhat indicative. The decline in health among recent non-European immigrants did not seem to be

associated with daily smoking initiation. They were, however, much more likely than the Canadian-born population to have had a substantial weight gain since immigrating. This result must be regarded cautiously.

Even with longitudinal data, some causal relationships cannot be confirmed. While recent non-European immigrants were more likely than the Canadian-born to report a weight gain, it cannot be concluded that the decline in self-perceived health was attributable to the increase in weight.

With longitudinal data it is possible to document the decline in immigrants' health and broadly identify the group most affected: those of non-European origin. They constitute an increasingly important segment of Canadian society, as the majority of recent immigrants (75%) come from non-European countries. This analysis is an attempt to better understand the health impact of the immigration process, as they adjust to life in Canada. ■

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Appendix

Table A

Adjusted risk ratios for transition from good/very good/excellent health to fair/poor health, by immigration status, duration of residence, and other selected characteristics, healthy[†] private household population aged 18 or older, Canada excluding territories, 1994/95 to 2002/03

| | Adjusted risk ratio | 95% confidence interval |
|---|---------------------|-------------------------|
| Immigration status and duration of residence | | |
| Canadian-born [‡] | 1.0 | ... |
| Recent European immigrants | 0.5 | 0.1, 2.1 |
| Long-term European immigrants | 1.2 | 1.0, 1.4 |
| Recent non-European immigrants | 2.3** | 1.6, 3.3 |
| Long-term non-European immigrants | 1.7** | 1.3, 2.4 |
| Sex | | |
| Men [‡] | 1.0 | ... |
| Women | 1.1 | 0.9, 1.2 |
| Age group | | |
| 18-34 [‡] | 1.0 | ... |
| 35-54 | 1.6** | 1.3, 1.9 |
| 55+ | 3.4** | 2.8, 4.1 |
| Income adequacy | | |
| Low | 1.5** | 1.3, 1.7 |
| Not low [‡] | 1.0 | ... |
| Education | | |
| Less than secondary graduation | 1.9** | 1.6, 2.2 |
| Secondary graduation/Some postsecondary | 1.2* | 1.0, 1.4 |
| Postsecondary graduation [‡] | 1.0 | ... |
| Smoking | | |
| Daily smoker | 1.5** | 1.3, 1.7 |
| Not daily smoker [‡] | 1.0 | ... |
| Inactive leisure | | |
| No [‡] | 1.0 | ... |
| Yes | 1.2** | 1.0, 1.3 |
| Social support | | |
| High [‡] | 1.0 | ... |
| Low | 1.3* | 1.0, 1.5 |
| Social involvement | | |
| High [‡] | 1.0 | ... |
| Low | 1.1 | 1.0, 1.2 |
| Body mass index[§] | | |
| Underweight | 1.0 | 0.7, 1.6 |
| Normal weight [‡] | 1.0 | ... |
| Overweight | 1.2** | 1.0, 1.4 |
| Obese | 1.3** | 1.1, 1.6 |

Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file.

Note: All explanatory variables are based on situation in 1994/95. Because of rounding, some confidence intervals with 1.0 as upper/lower limit are significant.

[†] Reported good, very good or excellent health in 1994/95.

[‡] Reference category.

[§] Excludes pregnant women.

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

** Significantly different from reference category ($p < 0.01$).

... Not applicable.

Table B

Adjusted risk ratios for health care utilization, by immigration status, duration of residence and other selected characteristics, healthy[†] private household population aged 18 or older, Canada excluding territories, 1994/95 to 2002/03

| | Doctor contacts became frequent [‡] | | Hospitalized for at least one night [§] | |
|---|--|-------------------------|--|-------------------------|
| | Adjusted risk ratio | 95% confidence interval | Adjusted risk ratio | 95% confidence interval |
| Immigration status and duration of residence | | | | |
| Canadian-born ^{††} | 1.0 | ... | 1.0 | ... |
| Recent European immigrants | 0.7 | 0.4, 1.2 | 0.6 | 0.3, 1.3 |
| Long-term European immigrants | 1.1 | 0.9, 1.2 | 1.0 | 0.8, 1.2 |
| Recent non-European immigrants | 1.5** | 1.1, 2.1 | 0.9 | 0.6, 1.4 |
| Long-term non-European immigrants | 1.1 | 0.8, 1.4 | 0.8 | 0.5, 1.3 |
| Sex | | | | |
| Men ^{††} | 1.0 | ... | 1.0 | ... |
| Women | 1.6** | 1.5, 1.8 | 1.4** | 1.2, 1.6 |
| Age group | | | | |
| 18-34 ^{††} | 1.0 | ... | 1.0 | ... |
| 35-54 | 0.9* | 0.8, 1.0 | 0.8** | 0.7, 1.0 |
| 55+ | 1.4** | 1.2, 1.6 | 1.8** | 1.5, 2.1 |
| Income adequacy | | | | |
| Low | 1.1 | 0.9, 1.2 | 1.1 | 0.9, 1.3 |
| Not low ^{††} | 1.0 | ... | 1.0 | ... |
| Education | | | | |
| Less than secondary graduation | 1.1 | 0.9, 1.2 | 1.3** | 1.2, 1.5 |
| Secondary graduation/Some postsecondary | 1.0 | 0.9, 1.2 | 1.0 | 0.9, 1.2 |
| Postsecondary graduation ^{††} | 1.0 | ... | 1.0 | ... |

Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file.

Note: All explanatory variables are based on situation in 1994/95. Because of rounding, some confidence intervals with 1.0 as upper/lower limit are significant.

[†] Reported good, very good or excellent health in 1994/95.

[‡] 6 or more contacts in previous year; based on non-frequent visitors to doctors in 1994/95.

[§] Not hospitalized in 1994/95.

^{††} Reference category.

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

** Significantly different from reference category ($p < 0.01$).

... Not applicable.



Table C
Adjusted risk ratios for health-related behaviours, by immigration status and duration of residence and other selected characteristics, healthy[†] private household population aged 18 or older, Canada excluding territories, 1994/95 to 2002/03

| | Became daily smoker [†] | | Became inactive during leisure [§] | | 10% or more increase in body mass index ^{††} | |
|---|----------------------------------|-------------------------|---|-------------------------|---|-------------------------|
| | Adjusted risk ratio | 95% confidence interval | Adjusted risk ratio | 95% confidence interval | Adjusted risk ratio | 95% confidence interval |
| Immigration status and duration of residence | | | | | | |
| Canadian-born ^{††} | 1.0 | ... | 1.0 | ... | 1.0 | ... |
| Recent European immigrants | 1.1 | 0.1, 9.9 | 2.2** | 1.2, 3.9 | 1.5 | 0.9, 2.5 |
| Long-term European immigrants | 0.9 | 0.6, 1.5 | 1.0 | 0.8, 1.2 | 0.9 | 0.8, 1.1 |
| Recent non-European immigrants | 0.5 | 0.2, 1.2 | 1.4 | 0.9, 2.3 | 1.8** | 1.4, 2.5 |
| Long-term non-European immigrants | 0.4* | 0.2, 0.9 | 1.2 | 0.7, 1.8 | 1.0 | 0.7, 1.4 |
| Sex | | | | | | |
| Men ^{††} | 1.0 | ... | 1.0 | ... | 1.0 | ... |
| Women | 0.7** | 0.4, 0.8 | 1.1 | 1.0, 1.2 | 1.2** | 1.1, 1.4 |
| Age group | | | | | | |
| 18-34 ^{††} | 1.0 | ... | 1.0 | ... | 1.0 | ... |
| 35-54 | 0.6** | 0.5, 0.7 | 1.0 | 0.8, 1.1 | 0.7** | 0.6, 0.8 |
| 55+ | 0.2** | 0.1, 0.3 | 1.1 | 1.0, 1.3 | 0.4** | 0.3, 0.5 |
| Income adequacy | | | | | | |
| Low | 1.8** | 1.2, 2.7 | 1.3** | 1.1, 1.5 | 1.2** | 1.1, 1.4 |
| Not low ^{††} | 1.0 | ... | 1.0 | ... | 1.0 | ... |
| Education | | | | | | |
| Less than secondary graduation | 1.7** | 1.2, 2.4 | 1.5** | 1.3, 1.8 | 1.2** | 1.1, 1.4 |
| Secondary graduation/Some postsecondary | 1.4* | 1.0, 1.9 | 1.1 | 1.0, 1.2 | 1.1* | 1.0, 1.3 |
| Postsecondary graduation ^{††} | 1.0 | ... | 1.0 | ... | 1.0 | ... |

Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file.

Note: All explanatory variables are based on situation in 1994/95. Because of rounding, some confidence intervals with 1.0 as upper/lower limit are significant.

[†] Reported good, very good or excellent health in 1994/95.

[‡] Not daily smoker in 1994/95.

[§] Active leisure time in 1994/95.

^{††} Excludes those who were underweight in 1994/95.

^{†††} Reference category.

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

** Significantly different from reference category ($p < 0.01$).

... Not applicable.



Definitions

Self-perceived health was measured on a five-category scale: poor, fair, good, very good or excellent. In this analysis, good health was defined as those reporting good, very good or excellent health.

Frequent doctor contacts was defined as six or more contacts (in person or by telephone) with a general practitioner or other medical doctor in the previous year. Six contacts was used as the cut-off because it was far above the median of two contacts for the Canadian population in 1994/95.

Hospitalization was defined as having spent at least one night in a hospital, nursing home or convalescent home.

Daily smokers were those who currently smoked every day.

Respondents were considered to be *inactive during leisure time* if they engaged in activities that were not vigorous enough to require expending at least 1.5 kcal/kg/day—the equivalent of walking briskly for 30 minutes every day, or bowling or practising yoga or tai-chi for at least 45 minutes daily.

Body mass index (BMI) was obtained by dividing weight in kilograms by the square of height in metres. The measure excluded pregnant women and those shorter than 0.91 metre (3 feet) or taller than 2.13 metres (7 feet). In accordance with the recommendations of the World Health Organization, four BMI categories were defined: underweight (less than 18.5); normal weight (18.5 to less than 25.0); overweight (25.0 to less than 30.0); and obese (30.0 or more).

Social support was measured with four items that reflected whether respondents felt that they had someone they could confide in, count on, who could give them advice, and who made them feel loved. Scores could range from 0 to 4, with higher scores indicating greater perceived social support. A score of 2 or more was considered to be high social support. Low social support, though a risk factor for health loss, was not included in the main analysis since the questions asked were identical only in the first two NPHS cycles.

Social involvement was measured by two items that reflected the frequency of participation in associations or voluntary organizations and the frequency of attendance at religious services in the last year. Scores could range from 0 to 8, with higher scores indicating greater social involvement. A score of 2 or more was considered to be high social involvement.

Three *age groups* were specified for the analysis: 18 to 34, 35 to 54, and 55 or older.

Level of *education* was defined as less than secondary graduation, secondary graduation/some postsecondary, and postsecondary graduation.

Low income adequacy was based on the number of people in the household and total household income from all sources in the previous 12 months. It was defined as less than \$15,000 for a household with 1 or 2 persons, less than \$20,000 for a household with 3 or 4 persons, and less than \$30,000 for a household with 5 or more persons.



Methods

Data source

Since 1994/95, Statistics Canada's biennial National Population Health Survey (NPHS) has collected information about the health of the Canadian population. The survey covers private household and institutional residents in all provinces, except residents of Indian reserves, Canadian Forces bases, and some remote areas.

For each of the first three cycles (1994/95, 1996/97 and 1998/99), two cross-sectional files were produced: General and Health. The General file contains socio-demographic and some health information (collected using the General questionnaire) for each member of participating households. The Health file contains additional, in-depth health information (collected using the Health questionnaire) about one randomly selected household member, as well as the information from the General file pertaining to that individual. Starting in 2000/01 (cycle 4), the NPHS became strictly longitudinal, and the General and Health questionnaires were combined.

A longitudinal file is also produced for each cycle. In 1994/95, a member of each selected household was randomly chosen to be in the longitudinal panel (17,276), and these longitudinal panel members were followed over time. The response rates for this panel for subsequent cycles were 92.8% in cycle 2 (1996/97), 88.2% in cycle 3 (1998/99), 84.8% in cycle 4 (2000/01) and 80.6% in cycle 5 (2002/03). More detailed descriptions of NPHS design, sample and interview procedures can be found in published reports.²⁴

Analytical techniques

All five cycles of NPHS household data (1994/95 to 2002/03) were used to trace changes in immigrants' self-perceived health. For people who were healthy in 1994/95 (good, very good or excellent self-perceived health), changes in health status, health care utilization (frequent doctor contacts and hospitalization) and health-related behaviours (daily smoking, leisure inactivity and body mass index) were compared, by European/non-European origin and by duration of residence in Canada. The analysis controlled for age, sex, household income, education and other selected characteristics as of 1994/95, as specified in the charts and tables. Changes in these factors after 1994/95 were not taken into account.

A discrete proportional hazards model was used, since this method allows researchers to study the timing of events and its association with various characteristics.^{25,26} The model was specified with Proc Logistic in SAS (Version 8.02) with a complementary log-log model, which is equivalent to using Cox proportional hazards (Proc PHREG, ties=exact in SAS).²⁶ Since the NPHS longitudinal interviews were conducted only once every two years, there were many tied occurrence of events (such as health loss in this analysis). This method allows for the

possibility that some observations are not observed for the entire study period (as respondents could be lost to follow-up) and minimizes the bias introduced by such attrition.

Private household population aged 18 or older, by immigration status and duration of residence, Canada excluding territories, 1994/95

| | Sample | Estimated population '000 |
|-----------------------------|---------------|---------------------------|
| Total | 14,117 | 21,137 |
| Canadian-born | 12,038 | 16,756 |
| All immigrants [†] | 2,079 | 4,384 |
| European | 1,356 | 2,469 |
| Recent | 147 | 311 |
| Long-term | 1,209 | 2,159 |
| Non-European | 722 | 1,911 |
| Recent | 324 | 955 |
| Long-term | 398 | 956 |

Data source: 1994/95 to 2002/03 National Population Health Survey, longitudinal file

† Includes unknown country of birth

The main interest in this analysis was the timing to first event (such as the first transition from good, very good or excellent health in 1994/95 to fair or poor health thereafter). All relevant cases were included, regardless of whether they participated in all cycles. Thus, the analysis includes respondents who missed some of the intermediate cycles in terms of outcome variables. Wave length (the number of intervals) and wave length square were included in the model to correct for the fact that the longer the interval between observations, the more likely the occurrence of an event.

Proportional hazards models were fitted to estimate the relative risks of transitions in self-perceived health, doctor visits, hospitalization, daily smoking, leisure activity and body mass index (at least 10% gain) for each immigrant status group. For respondents whose health was good, very good or excellent in 1994/95 (the initially healthy cohort), the relative risks of a transition to fair or poor health were examined. For health care utilization, the relative risks of increasing physician contacts (from less than six to six or more per year) or hospitalization (from none to at least one) were examined among the initially healthy cohort. For health-related behaviours, the relative risks that those who did not smoke daily or had active leisure time pursuits in 1994/95 would become daily smokers or become inactive in leisure time were calculated for the initially healthy cohort. Similarly, the relative risks of a 10% or more increase in body mass index were calculated (excluding those who were underweight in 1994/95).

For the estimates of variances and confidence intervals in all analyses, bootstrap weights were used to account for clustering and the unequal probabilities of selection into the survey.^{27,28}

