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ORIGINAL ARTICLE

Coming to Canada: the difference in health trajectories between immigrants and native-born residents

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Abstract
Objectives This study investigates improvements as well as declines in health with four health measures for immigrants and native-born residents.
Methods We used longitudinal data from Statistics Canada National Population Health Survey, which represented 8,474 native-born residents and 1,339 immigrants from 1994/95 to 2004/05. Multinomial logistic regressions were used to evaluate self-perceived health, chronic condition, health utility index, and body mass index.
Results The results showed that some immigrants were more likely to report a decline in health, while others were more likely to report an improvement in health relative to native-born residents. For example, immigrants had a higher odds ratio of both reporting (1.63: 95 % CI 1.22–2.18) and no longer reporting (1.49: 95 % CI 1.04–2.14) a chronic condition in subsequent survey years than native-born residents.
Conclusions Our finding may be attributable to immigrants inconsistently reporting, or a dichotomous health trajectory. Longitudinal data with physical measurements may be required to decipher our observations.

Keywords Immigrants · Health · Longitudinal survey data · Canada

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Introduction

Immigrants have been well-documented (Hyman 2007; Jasso et al. 2004) to have a health advantage over native-born residents on arrival, but have it disappear as time passes. This has been denoted as the Healthy Immigrant Effect (HIE). The concern is why are immigrants' health declining in the host countries. Plausible explanations have been proposed. The relatively steep decline in immigrants' health may imply that necessary health services are not received in the host country. Differences in language and culture are often suggested as barriers (Frisbie et al. 2001; Newbold 2005). Second, the decline in health may be explained by acculturation, e.g., immigrants adopting native-born residents' high-fat diets or inactive lifestyle (Antecol and Bedard 2006). Understanding HIE is significant given that immigrants in most Western countries represent a large and increasing percentage of the total population—in Canada, immigrants represent 19.8 % in 2006 and has increased 13.3 % since 2001 (Statistics Canada 2007). Decision makers have in response introduced, for example, a preventative screening guideline in Canada (Pottie et al. 2010), or expanded Medicaid coverage to uninsured legal immigrants in the United States (US) (National Immigration Law Center 2010).

Immigrants' decline in health relative to native-born residents over time has been documented for health conditions and behaviours. Ali (2002) and Lou and Beaujot (2006) show that immigrants had higher rates of mental health problems (e.g., depression) than native-born residents as their duration in Canada lengthened. Similar evidence has also been found for coronary heart disease, diabetes, cancer, and hypertension (Hyman 2007; Perez 2002; Vissandjee et al. 2004). The odds of health risk behaviours, such as obesity, smoking status and physical

inactivity are also found to increase significantly as immigrants' duration in the US increased from less than 5–10 years or more years (Frisbie et al. 2001; Antecol and Bedard 2006). For self-perceived health, Sousa et al. (2010) show immigrants' were more likely to report poor perceived health than native-born Spanish residents as their duration in the host country increased beyond 3 years. Differences in perceived health, however, are found to vary with immigrants' employment conditions, i.e., temporary, permanent, or contract. While most studies find a steeper decline in immigrant health over time, a few studies show the contrary (Leao et al. 2009; Robertson et al. 2003). For example, Leao et al. (2009) show that immigrants residing in Sweden fewer than 15 years had a higher odds of reporting poor self-rated health than the majority population, while immigrants with duration of greater than 15 years differed insignificantly.

A growing body of literature uses longitudinal data to determine the health trajectories of immigrants (Newbold 2005; Chiswick et al. 2004; 2008; Newbold 2009). The main advantage of longitudinal data is it follows the same immigrant over time to infer changes in health, while cross-sectional studies make the same inference by comparing recently arriving immigrants to long-term immigrants. An important disadvantage of longitudinal data is the potential bias from loss to follow-up. This may occur if immigrants' health differs from native residents' health among respondents who dropped out of the survey. Immigrants may drop out more often than native residents because immigrants move more often with fewer attachments to family and friends, return migration, and/or their willingness to improve their education and occupational opportunities. In particular, Sanders (2007) shows that immigrants' decline in health can be potentially explained by unhealthy male immigrants' lower likelihood to return to their home country than healthy male immigrants', given the superior quality of the host country's health care system.

Most of the longitudinal studies find evidence supporting a decline in immigrant health over time. These studies also help exclude potential explanations or provide further detail to current explanations. Ronellenfitsch and Razum (2004) find that Eastern European immigrants have a steeper deterioration in health than native-Germans after a 5-year follow-up period, but this decline could not be attributed to differences in socioeconomic status. Chiswick et al. (2008) show with Australian longitudinal data that immigrants' self-reported health status decreased over 3 years, which could not be explained by population aging or healthier immigrants returning to their home country. Newbold (2009) finds a similar finding using Canadian longitudinal data. The study shows that within 4 years of arrival, the proportion of immigrants reporting fair or poor health had nearly tripled, while the proportion reporting excellent health declined from 36 to 19.5 %. It is also found that almost half of all immigrants report a new physical problem after 4 years of their arrival.

Most longitudinal studies focus only on changes in immigrant health and do not compare with native-born residents. The two longitudinal studies that make this comparison find immigrants have a higher likelihood of health decline relative to native-born residents (Newbold 2005; Ng et al. 2005). Newbold (2005) finds this decline to occur rapidly within 5–10 years of arrival for self-assessed health. Ng et al. (2005) finds the higher likelihood of decline for non-European immigrants' physical activity, obesity, and self-assessed health. Both of the longitudinal studies focus only on transitions to poor health status, which may overlook immigrants who have successfully managed their health. We investigate improvements as well as declines in health with four health measures, and compare immigrants to native-born residents with 10 years of longitudinal data.

Methods

Data source

We analyzed Statistics Canada's National Population Health Survey (NPHS) from 1994/95 to 2004/05. The NPHS biennially collected socio-demographic and health information from the same respondents for 10 years. A member of each selected household was randomly chosen to be interviewed. All households surveyed were composed of private households and institutional residents in all provinces except residents of Indian reserves, Canadian Forces bases, and some remote area. The response rate in the 1994/95 survey cycle was 83.6 % (Statistics Canada 2005), which resulted in a sample of 17,276 respondents. Sample weights were used in both the descriptive and regression analysis, which was the longitudinal square weight, i.e., WT64LS (for further information, please refer to Statistics Canada 2008). The weights were based on the sample selected in the initial 1994/95 survey cycle, and 1996 Census population estimates for age groups (0–11, 12–24, 25–44, 45–64, 65 and older) and sex within each province.

We focused only on respondents who responded to all survey waves or respondents who responded to survey waves consecutively but dropped out in all future survey waves. In particular, we excluded all respondents (i.e., 2,353 respondents or 13.6 % of all respondents) with missing values, i.e., intermittent responses for any of the health outcomes or covariates in any of the survey years. This exclusion allowed us to determine the change in health outcome between each survey wave for the same

respondents across all years. Without this exclusion, the change in health would be calculated over a longer time period for respondents with missing responses than all other respondents. Our final sample was 9,813 respondents, which was followed from 1994/95 to 2004/05 survey cycle. The 9,813 respondents represented 8,474 native-born residents and 1,339 immigrants. We defined immigrant status as respondents who self-reported their status as being born outside of Canada as of 1994/95 survey cycle, i.e., immigrants who are first-generation immigrants. We did not include second-generation immigrants, i.e., respondents born in Canada but with one foreign-born parent in this definition because we were interested in the health effects associated with being an immigrant. Second-generation immigrants were classified as native-born residents.

Health outcomes

The following four binary outcomes were chosen based on their common-use in the literature, Obese (Goel et al. 2004; Antecol and Bedard 2006), perceived fair/poor health (Newbold 2005, 2009; Ng et al. 2005), fair/poor Healthy Utility Index Mark 3 (HUI3) (Newbold and Danforth 2003), and self-reported chronic condition (Perez 2002; Deri 2008). Overweight/Obese equalled one if respondents' derived body mass index (BMI) was greater than or equal to 25. BMI was calculated with self-reported weight (in kilograms) divided by height-squared (in meters). Perceived fair/poor health equalled one if respondents reported poor or fair health status, which represented a 5-point Likert-type scale. Fair/poor HUI3 equalled one if respondents HUI3 was greater than or equal to the median of HUI3. The HUI3 used eight attributes (vision, hearing, speech, ambulation, dexterity, emotion, cognition, and pain) to represent respondents' health status and health related quality of life. Chronic condition equalled one if respondents reported one of the following eight medical conditions: heart disease, diabetes, kidney disease, human immunodeficiency virus (HIV), high blood pressure, cancer, intestinal and stomach ulcers, and dementia.

Statistical analysis

First, we compared the proportion of immigrants with each health outcome to native-born residents for each survey wave. Next, we calculated changes in respondents' health over time by determining whether their response changed from the previous survey wave. There were three potential outcomes, i.e., respondents who reported no change, an improvement in health, or decline in health. We did not assume that respondents who reported a different health status in a subsequent survey year remained that status for all future survey waves.

Next, multinomial logistic regression was used to estimate the odds of reporting an improvement and decline in health (which was both relative to reporting no change in health). The main covariate of interest was immigrant status, which represented a binary variable indicating one for all foreign-born respondents and zero otherwise. We controlled for age (respondents who are 18 years old and older), sex, region of residence, marital status, education, household size, income, ethnicity, can converse in English, and immigrant status. We chose these covariates because of their importance in the literature as determinants of immigrant health. In particular, Ng et al. (2005) showed that differences in immigrants' ethnicity, i.e., respondents identifying themselves of European origin versus Asia origin, or native-born Chinese residents versus Chinese immigrants influence health trajectories. We defined ethnicity based on respondents' self-identification to the following question: "To which ethnic or cultural group(s) did your/his/her ancestors belong?" This self-identification corresponded to a mix of cultural and other factors including language, diet, religion, ancestry, and physical features traditionally associated with race (Bhopal 2004).

We also included a time trend (survey years), the number of years since immigration (i.e., 1994/95—year of immigration) and its square. We included a time trend to account for year-to-year changes that may affect respondents' health over time, or changes in survey waves that may influence responses. The inclusion of number of years since immigration controlled for cohort effects from immigrants arriving to Canada in different periods of time. We also included dummy variables representing whether respondents dropped out of the survey data, in order to account for the influence of survey attrition (Jones 2007). All analyses were performed using the statistical software program, Stata version 10.1 (Stata Corp, College Station, Tex).

Results

Characteristics of the study population in 1994/95 survey year

Table 1 shows that the majority of the sample was represented by native-born residents (81.15 %). Recent immigrants represented foreign-born respondents living in Canada fewer than 10 years since the 1994/95 survey year, while long-term immigrants represented all other foreign-born respondents. Both recent and long-term immigrants had a higher proportion residing in Ontario or British Columbia, married, and university educated than native-born residents. Recent immigrants tended to be younger (64.97 % between the ages of 18 and 39), lived in larger household sizes (40.47 % living in 4+ persons in a

Table 1 Characteristics of the study population, 1994/95–2004/05, Canada

Variables	Recent		Long-term		Native-born residents	
	n	Wtd. (%)	*n*	Wtd. (%)	*n*	Wtd. (%)
Overall	1,482	4.25	6,552	14.60	50,850	81.15
Province						
Atlantic Provinces	49	0.57	363	1.48	11,656	8.28
Quebec	142	12.44	429	9.15	8,193	24.30
Ontario	496	40.65	2,433	46.22	9,105	27.47
British Columbia	178	12.59	871	13.51	3,557	9.21
Prairie Provinces	194	7.58	979	9.20	9,781	14.66
Attrition	423	26.17	1,477	20.43	8,558	16.08
Sex						
Male	726	52.82	3,168	51.52	24,318	50.65
Female	756	47.18	3,384	48.48	26,532	49.35
Age						
18–39	1,020	64.97	1,524	27.02	22,188	46.20
40–59	336	23.09	2,682	45.18	17,052	34.99
60+	126	11.94	2,346	27.79	11,610	18.80
Household size						
1	134	4.95	1,265	11.20	9,104	13.05
2	218	12.01	1,765	26.35	14,959	28.70
3	212	16.49	810	15.12	7,534	15.97
4	276	21.31	841	16.84	7,185	16.70
5+	219	19.16	394	10.08	3,510	9.50
Attrition	423	26.17	1,477	20.43	8,558	16.08
Marital status						
Married	737	55.04	3,497	60.25	28,340	59.95
Separated	155	9.33	1,138	12.49	8,601	13.97
Single	167	9.45	440	6.83	5,351	9.99
Attrition	423	26.17	1,477	20.43	8,558	16.08
Education						
Less than Secondary	73	5.96	440	6.24	2,305	3.73
Secondary	214	15.50	1,404	20.56	14,213	26.66
Trade School	197	12.00	1,075	16.09	9,350	18.23
University	575	40.37	2,158	36.68	16,426	35.30
Attrition	423	26.17	1,477	20.43	8,558	16.08
Income						
<$30,000	329	20.51	1,568	18.15	13,297	20.56
$30,000–$60,000	382	27.12	1,579	25.11	14,792	29.60
$60,000+	289	21.97	1,589	30.71	11,968	29.40
Attrition/non response	482	30.40	1,816	26.03	10,793	20.44
Ethnicity						
Canadian	0	0.00	60	0.87	8,274	16.98
French	30	1.64	126	1.59	9,522	23.06
English	54	2.78	1,026	12.28	7,920	12.98
European	276	13.95	2,610	36.69	19,176	34.46
Chinese	282	19.69	300	6.62	96	0.32
Portuguese	54	3.46	204	3.49	96	0.33
South Asian	102	11.38	186	4.05	36	0.08
Black	90	4.69	168	2.97	84	0.19

Table 1 continued

Variables	Recent		Long-term		Native-born residents	
	n	Wtd. (%)	*n*	Wtd. (%)	*n*	Wtd. (%)
Other	594	42.41	1,872	31.44	5,646	11.60
Converse in English						
No	145	11.11	252	4.17	5,333	14.25
Yes	914	62.72	4,825	75.40	36,961	69.67
Attrition	423	26.17	1,477	20.43	8,558	16.08

HUI3 Health Utility Index3

Recent immigrants represented respondents living in Canada fewer than 10 years, while long-term immigrants represented all other foreign-born respondents. The number of years since immigration was calculated from the 1994/95 survey year

% represented weighted percentages of person-year counts

n represented the unweighted person-year counts. Age is calculated in the 1994/95 survey year which increases in 2 year increments for the subsequent survey cycles

household), and can converse in English less (62.72 % can converse in English) than the other two groups. Further, a higher proportion of recent immigrants reported that they were Chinese (19.69 %), South Asian (11.38 %), or Other ethnicity (42.41 %) than long-term immigrants. Long-term immigrants tended to be older (27.79 % was older than 60 years old) and earned the highest income (30.71 % earned more than $60,000) than the other two groups.

The change in health over time from 1994/95 to 2004/05

Figure 1 shows the proportion of respondents representing the four health outcomes over the 10 years of longitudinal survey data. The proportion of immigrants who were obese increased at a steeper rate than native-born residents, which eventually converged to the same proportion as native-born residents by 2004/05. However, immigrants' decline in health trajectory relative to native-born residents was not found for the other three measures. In particular, we found the proportion of fair/poor perceived health and HUI3 was higher for immigrants than native-born. Thus, the longitudinal evidence did not clearly illustrate the decline in immigrants' health trajectory for all four health outcomes.

Table 2 shows the odds of reporting a change in health measure from the previous survey wave, which was estimated with a multinomial logistic regression. The results showed that immigrants were more likely than native-born residents to report a decline in HUI3 [risk adjusted odds ratio (aOR): 1.51, 95 % CI: 1.08–2.13], obesity (aOR: 1.89, 95 % CI: 1.25–2.86) and presence of any one of the eight chronic conditions (aOR: 1.63, 95 % CI: 1.22–2.18) The odds ratio for transitioning to poor/fair perceived health in future survey waves was not significantly different (aOR: 1.14, 95 % CI: 0.70–1.88).

We also assessed improvements in self-reported health status between immigrants and native-born residents (see Table 3). We found immigrants were more likely to have a health improvement than native-born residents in terms of self-reported HUI3, obesity, and presence of chronic conditions. Again, we found that immigrants did not differ significantly from native-born residents in the odds of transitioning to poor/fair perceived health in future survey wave. Thus, the longitudinal evidence showed that not only immigrants were more likely to report poorer health over time than native-born residents, but were also more likely to report improvements in health over time.

Other associations with the change in health from 1994/95 to 2004/05

We found that many of the covariates influence changes in health, and were important to adjust for when examining the influence of immigrant status. In particular, respondents' age, household size, and ability to converse in English were important determinants in both the decline and improvement in health. Further, the characteristics' influence differed in the direction and magnitude between the likelihood of a decline in health and an improvement in health. For example, respondents earning $60,000 or more were 14 % (95 % confidence interval: 1.00–1.30) more likely than respondents earning $30,000 or less to report an improvement in health, but also were 28 % (95 % confidence interval: 1.09–1.51) more likely to report a decline in health.

In contrast, we found that the association for the years since immigration was small and statistically insignificant for all health measures (as shown in Tables 2, 3). In particular, the odds of becoming obese was 0.98 (95 % CI 0.96–1.01) for additional year since immigration. We

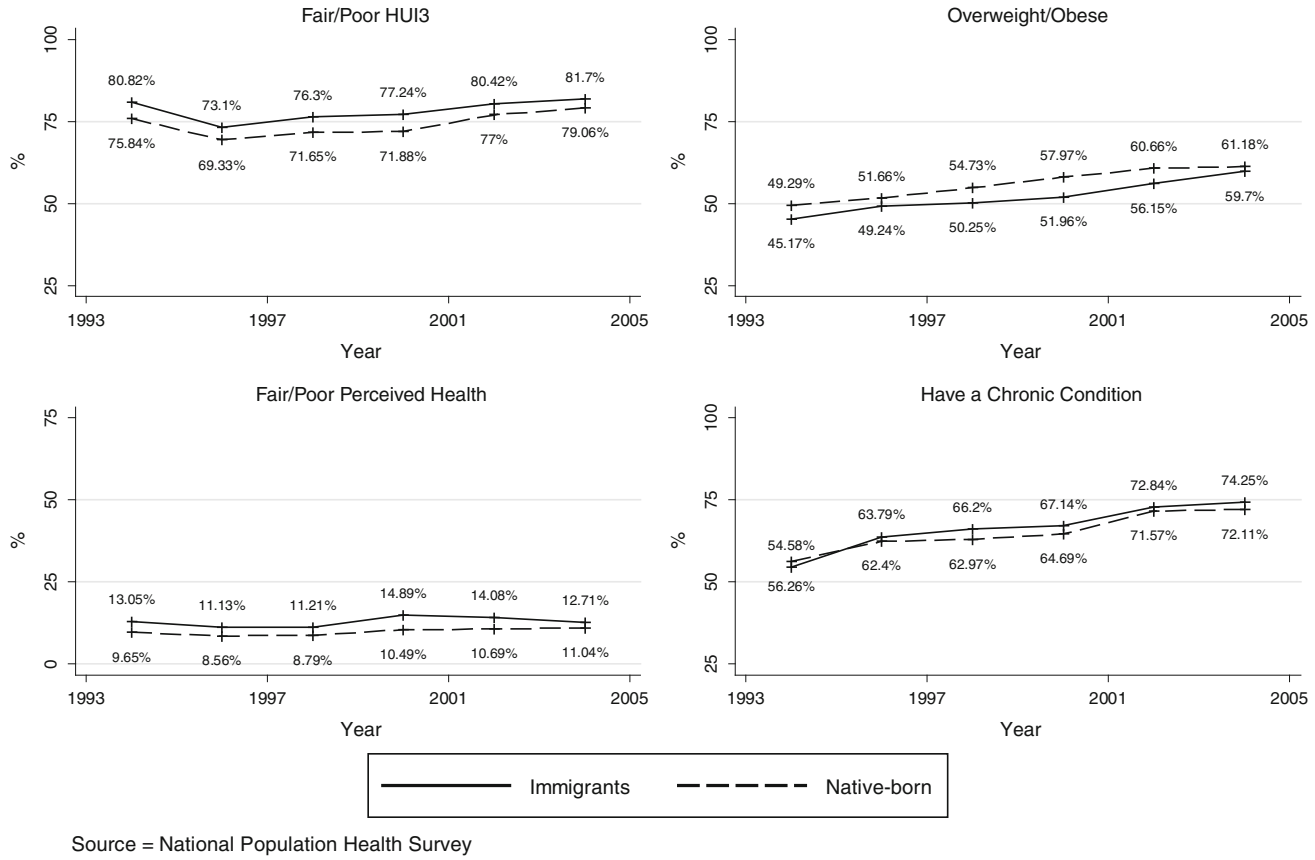

Fig. 1 The proportion of poor health outcome by immigrant status from 1994/95–2004/05 survey years

found that the odds of transitioning in all health measures were significant for the years since immigration squared, which may imply that duration of residence was non-linearly related to immigrants' transition in health. For the dummy variables indicating attrition status, we found their inclusion in our regressions had little influence on our estimates. Only for the perceived poor/fair health measure, we found that respondents dropping out of the survey differed significantly from those who did not drop out. In particular, immigrants dropping out of the survey had the highest odds ratio of 1.74 (95 % CI 1.27–2.39) for the likelihood of declining in health.

Discussion

We analyze 10 years of longitudinal survey data to answer whether the health status of immigrants is declining or improving faster than native-born residents. To answer this question, we define health status using four self-reported measures and analyze two health trajectories: declines and improvements in health. Surprisingly, we find that immigrants were more likely to report improvements as well as declines in their health relative to native-born residents based on three of the four measures. Our study highlights the following: (1) determining whether immigrants' health decline or improve over time depends on the measure of health status. In our study, self-perceived health status measure is shown to have no statistical difference between immigrants and native-born residents for both improvements and declines in health. (2) Health status measures are not static. Immigrants may be more likely than native-born residents to report health improvements in one survey cycle and report health declines in the subsequent cycle. This may be attributed to self-reported measures, which may vary considerably over time. (3) It is also possible that immigrants have a dichotomous health trajectory. Some immigrants may report a decline while others may report an improvement in health.

The last explanation is supported in the literature. Newbold (2009) shows that 3.7 % of immigrants reported a transition from excellent health status to poor/fair health status in 4 years, but also show that 6.5 % of immigrants reported the opposite transition. While both of our studies find a similar dichotomous result, Newbold (2009) does not show whether the two immigrant health trajectories occur

Table 2 The odd of reporting a decline in health from 1994/95 to 2004/05, Canada

Variables	Fair/poor HUI3		Obese		Chronic condition		Fair/poor perceived health	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Immigrant status								
Native-born resident	–	–	–	–	–	–	–	–
Immigrant	1.51	(1.08–2.13)	1.89	(1.25–2.86)	1.63	(1.22–2.18)	1.14	(0.70–1.88)
Years since immigration								
Number of YSI	0.98	(0.95–1.00)	0.98	(0.96–1.01)	0.99	(0.97–1.01)	1.00	(0.98–1.03)
Number of YSI squared	1.00	(1.00–1.00)	1.00	(1.00–1.00)	1.00	(1.00–1.00)	1.00	(1.00–1.00)
Region								
Atlantic	–	–	–	–	–	–	–	–
Quebec	0.97	(0.82–1.16)	1.12	(0.91–1.38)	1.12	(0.95–1.32)	0.71	(0.56–0.90)
Ontario	1.01	(0.89–1.16)	0.99	(0.85–1.15)	0.95	(0.84–1.07)	1.20	(1.01–1.42)
British Columbia	0.97	(0.82–1.15)	0.89	(0.73–1.09)	0.95	(0.81–1.11)	1.05	(0.84–1.30)
Prairie	1.11	(0.98–1.27)	0.99	(0.85—1.16)	0.95	(0.84–1.08)	1.04	(0.87–1.24)
Sex								
Male	–	–	–	–	–	–	–	–
Female	0.78	(0.71–0.86)	0.91	(0.82–1.02)	0.81	(0.75–0.88)	1.02	(0.90–1.15)
Age								
18–39	–	–	–	–	–	–	–	–
40–59	0.58	(0.52–0.65)	0.80	(0.70–0.92)	0.92	(0.83–1.01)	1.73	(1.48–2.03)
60+	0.31	(0.25–0.37)	0.72	(0.59–0.86)	0.61	(0.53–0.71)	2.59	(2.15–3.13)
Household size								
1	–	–	–	–	–	–	–	–
2	0.93	(0.79–1.09)	1.02	(0.85–1.23)	1.03	(0.90–1.19)	1.03	(0.87–1.22)
3	1.12	(0.94–1.35)	1.02	(0.82–1.27)	1.09	(0.92–1.28)	1.19	(0.94–1.49)
4	1.22	(1.01–1.48)	0.92	(0.74–1.16)	1.07	(0.90–1.27)	1.29	(1.01–1.67)
5+	1.29	(1.03–1.61)	1.16	(0.90–1.49)	0.93	(0.76–1.13)	1.29	(0.97–1.72)
Marital status								
Married	–	–	–	–	–	–	–	–
Separated	1.00	(0.87–1.15)	1.01	(0.85–1.20)	0.97	(0.86–1.1)	1.01	(0.85–1.21)
Single	1.07	(0.91–1.26)	1.08	(0.89–1.31)	1.00	(0.85–1.17)	1.00	(0.78–1.30)
Education								
Less than secondary	–	–	–	–	–	–	–	–
Secondary	1.16	(0.91–1.48)	0.95	(0.74–1.21)	1.03	(0.83–1.27)	0.84	(0.69–1.04)
Trade school	1.02	(0.79–1.30)	0.83	(0.64–1.06)	1.00	(0.80–1.25)	0.80	(0.63–1.00)
University	1.07	(0.84–1.37)	0.95	(0.75–1.22)	0.97	(0.78–1.21)	0.60	(0.48–0.76)
Income								
<$30,000	–	–	–	–	–	–	–	–
$30,000–$60,000	1.04	(0.91–1.19)	0.99	(0.85–1.15)	1.00	(0.89–1.12)	0.60	(0.52–0.69)
$60,000+	1.06	(0.91–1.24)	0.98	(0.82–1.16)	1.14	(1.00–1.30)	0.35	(0.29–0.42)
Missing	1.06	(0.85–1.33)	0.94	(0.73–1.19)	1.05	(0.86–1.27)	0.74	(0.58–0.94)
Ethnicity								
Canadian	–	–	–	–	–	–	–	–
French	0.99	(0.84–1.17)	0.94	(0.77–1.14)	0.96	(0.83–1.12)	1.01	(0.81–1.25)
English	1.03	(0.86–1.24)	1.18	(0.96–1.45)	0.90	(0.76–1.05)	0.98	(0.77–1.24)
European	0.99	(0.86–1.15)	1.03	(0.87–1.22)	0.90	(0.78–1.03)	0.96	(0.78–1.17)
Chinese	0.58	(0.38–0.91)	0.90	(0.50–1.62)	0.88	(0.60–1.30)	1.73	(0.89–3.39)

Table 2 continued

Variables	Fair/poor HUI3		Obese		Chronic condition		Fair/poor perceived health	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Portuguese	1.10	(0.65–1.85)	1.56	(0.92–2.66)	0.67	(0.41–1.09)	1.12	(0.55–2.29)
South Asian	0.62	(0.35–1.08)	0.60	(0.31–1.16)	0.81	(0.52–1.26)	1.39	(0.69–2.81)
Black	1.38	(0.89–2.15)	0.69	(0.33–1.44)	0.75	(0.51–1.10)	0.96	(0.50–1.85)
Other	0.93	(0.77–1.11)	1.04	(0.83–1.30)	1.04	(0.88–1.22)	1.28	(1.00–1.64)
Can converse in English								
No	–	–	–	–	–	–	–	–
Yes	0.82	(0.69–0.99)	0.98	(0.80–1.20)	0.90	(0.77–1.05)	0.73	(0.58–0.93)
Time trend	1.01	(0.99–1.03)	0.99	(0.97–1.01)	0.93	(0.91–0.94)	1.11	(1.09–1.13)
Attrition status								
No dropout	–	–	–	–	–	–	–	–
Dropout*Native-born	1.08	(0.93–1.25)	1.14	(0.98–1.34)	0.92	(0.81–1.04)	1.64	(1.41–1.92)
Dropout*Immigrant	1.01	(0.74–1.36)	0.88	(0.62–1.24)	0.71	(0.56–0.92)	1.74	(1.27–2.39)

The top category for categorical variables represented the reference category

HUI3 Health Utility Index3, *CI* confidence interval

The covariate of interest, Immigrant Status was a binary variable indicating one for all foreign-born residents and zero for native-born residents

Dropout indicated respondents who eventually dropped out of the survey

The number of observations was 58,884 (person-years) for all regressions

relative to native-born residents. Without this comparison, the different immigrant health trajectories can not be attributed to immigrant status. Nevertheless, this dichotomous result is underrepresented in the literature, and in particular, improvements in immigrant health are underemphasized.

The lack of emphasis results in overlooking the type of immigrant who would report improvements in their health. Newbold (2009) suggest that the type of immigrant that report improvements in health is likely to arrive to Canada with relatively low health status. These immigrants adjust well in the host country because they tend to be proficient in English, well-educated, and live outside of their ethnic enclave. Our study, however, does not find consistent evidence to support Newbold's (2009) conclusion. We find, for example, proficiency in English or relatively high income can have contrary effects on improvements in health. Another potential explanation to improvements in health is access to the health care system. For example, some immigrants may no longer report having hypertension if they are able to access and control their blood pressure with publicly provided medication, which are unavailable in their home country (Campbell et al. 2008). Immigrants with positive health trajectories may suggest that Canada have been successful at encouraging certain types of immigrants to access appropriate health services through health literacy programs and translational services (Simich 2009; Zanchetta and Poureslami 2006). Thus, further research into the characteristics underlying the type of immigrant who report improvements in health can benefit policies and program targeting immigrant health.

The other part of our dichotomous result shows that immigrants have a steeper decline in health than native-born residents over time. As well, this result can not be explained by the time of arrival. This decline and independence of time arrival is found in HIE literature (DeMaio 2010; McDonald and Kennedy 2004; Deri 2008). Canada has responded to this decline by recently implementing a preventative clinical guideline for immigrants and refugees (Pottie et al. 2010). The guideline makes immigrant-specific recommendations regarding cervical cancer, depression, contraception, hepatitis B, HIV, iron-deficiency anemia, oral health, pregnancy, tuberculosis, and vision health. This guideline can be further evolved if we can determine the reasons behind the success of some immigrants and difficulties of others. For example, successful non-European immigrants may pursue general practitioners of non-European ethnicity, which may improve patient compliance to prescription medication and follow-up treatment (Moy and Bartman 1995). This may imply that health providers not only have to provide culturally sensitive recommendations, but also have to further develop rapport with immigrants, in order to produce successful long-term outcomes (Saha et al. 1999).

Other western countries, like the United States has also responded by extending Medicaid coverage to uninsured legal immigrants in its recent health care reforms (National Immigration Law Center 2010). This reform is intended to reduce the rising cost of uncompensated hospital care for uninsured immigrants relying on emergency departments for health care (Okie 2005; Goldman et al. 2006). That is,

Table 3 The Odd of Reporting an Improvement in Health from 1994/95 to 2004/05, Canada

Variables	Fair/poor HUI3		Obese		Chronic condition		Fair/poor perceived health	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Immigrant status								
Native-born Resident	–	–	–	–	–	–	–	–
Immigrant	1.62	(1.12–2.34)	1.62	(1.03–2.55)	1.49	(1.04–2.14)	1.16	(0.64–2.11)
Years since immigration								
Number of YSI	0.97	(0.95–1.00)	0.99	(0.97–1.02)	0.99	(0.97–1.02)	1.02	(0.98–1.05)
Number of YSI-Squared	1.00	(1.00–1.00)	1.00	(1.00–1.00)	1.00	(1.00–1.00)	1.00	(1.00–1.00)
Region								
Atlantic	–	–	–	–	–	–	–	–
Quebec	1.03	(0.85–1.23)	1.09	(0.86–1.38)	1.19	(0.97–1.44)	0.73	(0.56–0.94)
Ontario	0.99	(0.86–1.14)	1.00	(0.85–1.19)	1.00	(0.86–1.16)	1.14	(0.94–1.38)
British Columbia	0.91	(0.76–1.10)	0.88	(0.71–1.10)	1.08	(0.90–1.30)	1.14	(0.89–1.44)
Prairie	1.08	(0.93–1.26)	0.92	(0.77–1.10)	1.00	(0.86–1.17)	1.05	(0.86–1.28)
Sex								
Male	–	–	–	–	–	–	–	–
Female	0.72	(0.65–0.79)	0.93	(0.82–1.05)	0.69	(0.62–0.77)	1.17	(1.02–1.35)
Age								
18–39	–	–	–	–	–	–	–	–
40–59	0.47	(0.41–0.54)	1.02	(0.87–1.20)	0.76	(0.67–0.86)	1.57	(1.32–1.88)
60+	0.28	(0.23–0.34)	1.35	(1.11–1.65)	0.55	(0.46–0.67)	2.21	(1.78–2.76)
Household size								
1	–	–	–	–	–	–	–	–
2	0.86	(0.73–1.02)	0.88	(0.73–1.07)	0.96	(0.81–1.14)	1.11	(0.91–1.36)
3	1.01	(0.84–1.21)	0.92	(0.72–1.18)	1.03	(0.85–1.24)	1.34	(1.04–1.73)
4	0.96	(0.79–1.17)	0.84	(0.64–1.10)	1.08	(0.88–1.32)	1.47	(1.10–1.95)
5+	1.14	(0.91–1.45)	1.09	(0.81–1.47)	0.96	(0.75–1.22)	1.31	(0.93–1.86)
Marital status								
Married	–	–	–	–	–	–	–	–
Separated	1.00	(0.86–1.16)	1.02	(0.85–1.23)	0.98	(0.83–1.14)	1.37	(1.12–1.66)
Single	1.09	(0.93–1.28)	0.91	(0.72–1.16)	1.19	(0.99–1.44)	1.06	(0.81–1.38)
Education								
Less than secondary	–	–	–	–	–	–	–	–
Secondary	1.31	(1.00–1.73)	0.97	(0.76–1.25)	0.90	(0.68–1.19)	0.69	(0.54–0.88)
Trade school	1.22	(0.92–1.62)	0.89	(0.68–1.16)	0.97	(0.73–1.29)	0.58	(0.44–0.75)
University	1.26	(0.95–1.67)	0.93	(0.72–1.21)	0.91	(0.68–1.21)	0.46	(0.35–0.61)
Income								
<$30,000	–	–	–	–	–	–	–	–
$30,000–$60,000	1.04	(0.92–1.19)	0.91	(0.77–1.08)	1.17	(1.03–1.34)	0.64	(0.54–0.76)
$60,000+	1.01	(0.87–1.19)	0.88	(0.72–1.07)	1.28	(1.09–1.51)	0.37	(0.30–0.45)
Missing	1.32	(1.06–1.65)	1.18	(0.91–1.53)	1.42	(1.13–1.78)	0.79	(0.62–1.02)
Ethnicity								
Canadian	–	–	–	–	–	–	–	–
French	1.03	(0.86–1.24)	1.02	(0.81–1.28)	1.02	(0.84–1.23)	1.15	(0.90–1.48)
English	1.11	(0.91–1.35)	1.33	(1.04–1.71)	1.01	(0.82–1.24)	1.07	(0.82–1.40)
European	1.02	(0.87–1.20)	1.15	(0.92–1.42)	1.07	(0.90–1.27)	0.96	(0.76–1.20)
Chinese	0.64	(0.40–1.03)	0.93	(0.49–1.75)	0.78	(0.49–1.23)	1.80	(0.89–3.64)
Portuguese	1.57	(0.93–2.63)	2.24	(1.26–4.00)	0.63	(0.32–1.26)	1.23	(0.62–2.45)
South Asian	0.77	(0.45–1.30)	0.44	(0.19–1.02)	1.04	(0.62–1.74)	1.71	(0.83–3.52)

Table 3 continued

Variables	Fair/poor HUI3		Obese		Chronic condition		Fair/poor perceived health	
	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Black	1.37	(0.78–2.40)	1.21	(0.60–2.46)	0.69	(0.38–1.22)	0.94	(0.47–1.89)
Other	1.00	(0.82–1.22)	1.16	(0.90–1.50)	1.10	(0.90–1.36)	1.16	(0.88–1.54)
Can converse in English								
No	–	–	–	–	–	–	–	–
Yes	0.95	(0.78–1.15)	1.01	(0.79–1.29)	0.88	(0.73–1.07)	0.92	(0.71–1.19)
Time trend	0.90	(0.88–0.91)	1.01	(0.98–1.03)	0.95	(0.93–0.97)	1.06	(1.03–1.08)
Attrition status								
No dropout	–	–	–	–	–	–	–	–
Dropout*Native born	1.06	(0.93–1.22)	1.12	(0.94–1.33)	0.97	(0.83–1.12)	1.26	(1.05–1.51)
Dropout*Immigrant	0.93	(0.68–1.27)	1.14	(0.81–1.59)	0.69	(0.49–0.96)	0.97	(0.66–1.45)

The top category for categorical variables represented the reference category

HUI3 Health Utility Index3, *CI* confidence interval

The covariate of interest, immigrant status was a binary variable indicating one for all foreign-born residents and zero for native-born residents

Dropout indicated respondents who eventually dropped out of the survey

The number of observations was 58,884 (person-years) for all regressions

US emergency departments are required to treat all individuals seeking care (including uninsured immigrants) under the Emergency Medical Treatment and Labor Act (Dubard and Massing 2007). It is unclear that an extension of Medicaid coverage will help prevent catastrophic and costly emergency situations from those immigrants postponing care. Our finding can not be generalized to the US because of differences in the immigrant population and policy environment. In particular, the US has a significant undocumented immigrant population, who are excluded federal coverage under the recent reforms and are restricted from purchasing private health insurance (National Immigration Law Center 2010). The US and other countries that have documented the HIE must also determine whether immigrants have different health trajectories. The identification of immigrants successfully managing their health provides an opportunity to understand their success and improve the health of immigrants overall.

The lack of association between immigrant status and change in perceived poor health is inconsistent with the dichotomous result for the other three health measures. It is often suggested that changes in self-perceived health are more changes in perceptions than real changes in health (Barnett et al. 2005; DuBard and Massing 2007; Lee et al. 2002). We also suspect that the inconsistent result between self-perceived health status and the other three health measures can be attributed to cultural differences. Leung et al. (2007) find inconsistent reporting between five-point Likert scales and number of chronic conditions for Chinese and Whites in Canada (Leung et al. 2007). Further, Lee et al. (2002) find that Chinese respondents tended to choose midpoints for Likert-type scales. Hunt and Bhopal's (2003) recommend that surveys design functionally and conceptually equivalent questions that are appropriate for all groups compared. This may imply a survey with culturally equivalent questions that allow for cross group comparisons, and some group specific questions, where no culturally equivalent questions exist, that allow comparison within the group.

Limitations

First, we use self-reported measures of health to represent respondents' health, which are subject to reporting differences between immigrants and native-born residents. Further, we may have left out important conditions that were unavailable in the NPHS, like mental health status, which may differ substantially between immigrants and native-born residents. However, the four health measures are commonly used in the literature and often referenced in the development of current immigrant policies and programs. Second, a significant proportion of respondents is lost to survey attrition by the last survey wave. We adjust for survey attrition with the use of dummy variables for attrition. Nevertheless, the recent collection of large, linked administrative databases over time in Canada may help to minimize the impact of attrition on measuring immigrant health trajectories (Creatore et al. 2010). Third, we are unable to distinguish different immigrant classes. Particularly, foreign-born residents represent economic immigrants, family class immigrants, and refugees. Finally, our results may be subject to a statistical tendency of immigrants, who

are healthier on arrival, reporting lower levels of health than native-born residents in subsequent periods, i.e., the regression toward the mean (RTM) problem (Barnett et al. 2005).

In summary, we find evidence of immigrants' reporting declines and improvements in health relative to native-born residents' over 10 years of longitudinal data. This may be attributable to immigrants inconsistently reporting. Concluding whether immigrants' health decline or improve relative to native born residents is dependent on health status measures. Alternatively, the result may suggest two observable immigrant health trajectories: one group of immigrants whose health improve after immigration and another whose health decline after immigration. However, longitudinal data with physical measurements is key to confirming this observation.

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Conflict of interest None declared.

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