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Myocardial infarction Associated with Recency of Immigration to Ontario

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Summary

Background: New immigrants to North America exhibit lower rates of obesity and hypertension than their native-born counterparts. Whether this is reflected by a lower relative risk of acute myocardial infarction (AMI) is not known.
Objective: To determine the risk of AMI among new immigrants compared to long-term residents, and, among those who develop AMI, their short- and long-term mortality rate.
Design: Population-based, matched, retrospective cohort study.
Setting: Entire province of Ontario, the most populated province in Canada, from 1 April 1995 to 31 March 2007.
Participants: A total of 965 829 new immigrants were matched to 3 272 393 long-term residents by year of birth, sex and geographic location.
Measurements: The main study outcome was hospitalization with a most responsible diagnosis of AMI. Secondary study outcomes among those who sustained an AMI were in-hospital, 30-day and 1-year mortality.
Results: The mean age of the participants at study entry was ~34 years. The incidence rate of AMI was 4.14 per 10 000 person-years among new immigrants and 6.61 per 10 000 person-years among long-term residents. After adjusting for age, income quintile, urban vs. rural residence, history of hypertension, diabetes mellitus and smoking and number of health insurance claims, the hazard ratio for AMI was 0.66 [95% confidence interval (CI): 0.63–0.69].
Conclusion: New immigrants appear to be at lower risk of AMI than long-term residents. This finding does not appear to be explained by the availability of health-care services or income level.

Background

Recent immigrants to the USA and Canada, most of whom are <50 years of age, tend to exhibit fewer risk factors for acute myocardial infarction (AMI), including obesity and chronic hypertension.[1] This so-called 'healthy immigrant effect'[2] may reflect the fact that those who emigrate to a new country are fit—both mentally and physically[3]—and can pass the medical examination administered to all potential new immigrants. The 'salmon effect' further suggests that immigrants who experience ill health and/or long-term unemployment return to their country of origin, thereby enhancing the health profile of the remaining cohort.[4]

In the province of Ontario, Canada, universal health care is available to all residents and detailed computerized medical records are also maintained. This enabled us to determine the risk of AMI amongst relatively young new immigrants to Ontario compared with long-term and native-born residents (hereafter called 'long-term residents'). Amongst those who had an AMI, we also compared the mortality rates between new immigrants and long-term residents.

Methods

Myocardial infarction Associated with Recency of Immigration to Ontario (MARIO) was a population-based, matched, retrospective cohort study. All participants had to be enrolled in the Ontario Health Insurance Plan (OHIP), which covers most aspects of health care and for which there is no user fee. All residents of Ontario are covered under OHIP, which becomes active within ~3 months of acquiring resident status. Details of the study methods are available elsewhere.[5] In brief, we included adults in the age range of 16–65 years at the time of inclusion to the study. New immigrants were defined as those who received a new OHIP number at any time between 1 April 1995 and 31 March 2006. Long-term residents were defined as those in the age range of 16–65 years who had an active OHIP number for 5 years or more during this same time period. Each new immigrant was matched to up to five randomly selected long-term residents by year of birth (within 365 days), sex and one of 14 geographically defined health networks. Adults >65 years were excluded because they represent a very small proportion of new immigrants to Canada, and our focus was mainly on AMI in middle-aged adults.

The main study outcome was hospitalization with a most responsible diagnosis of AMI. Secondary study outcomes following an AMI were in-hospital, 30-day and 1-year mortality.

We used three linked provincial health-care administrative databases, as described elsewhere.[6] The Registered Persons Database was used to identify the date of issue of a health-insurance number, a proxy for the date of arriving in Ontario. The Canadian Institute for Heath Information Discharge Abstract Database was used to identify a hospitalization for AMI—defined by an International Classification of Diseases Ninth (ICD-9) code of 410 or ICD-10 codes I21 or I22—as well as whether a patient was discharged alive or dead. The OHIP database of physicians billing information for outpatient and inpatient services was used to identify conditions diagnosed on an outpatient basis (e.g. pre-existing hypertension, diabetes mellitus and smoking), arising between the study-entry date and either the day before hospitalization for an AMI or the date of censoring, whichever came first.

The health-care databases were linked anonymously using encrypted individual health card numbers to safeguards for patient confidentiality. The project was approved by the Research Ethics Boards at Sunnybrook and St Michael's Hospitals.

Analyses

The period of observation for each new immigrant began on the date of the new OHIP number.[7] The period of observation for each long-term resident began on the same date as the new immigrant the person was matched to. Time-to-event analysis was performed up to 31 March 2007. An individual was censored if he/she died or reached the end of the study period.

The incidence rate of AMI was determined for both new immigrants and long-term residents. A survival curve was generated using the Kaplan–Meier procedure. Crude and adjusted hazard ratios (HRs) and 95% confidence intervals (CIs) were derived by multivariable Cox's proportional hazards models, with long-term residents serving as the referent category. Adjustment variables included age, income quintile, urban vs. rural residence, each at inclusion into the study, as well as diagnosed hypertension, diabetes mellitus or smoking and number of physician OHIP claims, each after inclusion into the study. Stratified analyses were conducted by participant characteristics at study entry, as listed in Figure 2.

Risk estimates for death were expressed as crude and adjusted odds ratios (ORs), derived using conditional logistic regression analysis and the same variables as in the Cox's proportional hazards model above.

All *P*-values were two sided, at a significance level of 0.05. Analyses were performed using Statistical Analysis Software (SAS) for UNIX (SAS Institute Inc., Cary, NC, USA).

Results

We excluded 201 individuals >65 years (98 immigrants and 103 long-term residents) of age. There were 965 829 participants classified as new immigrants and matched to 3 272 393 long-term residents.

The mean ages of the immigrant and long-term residents at inclusion into the study were 33 and 34 years, respectively; >80% were <45 years of age (Table 1).

After a median duration of follow-up of 5.5 years for new immigrants and 6.2 years for long-term residents, there were 2290 and 13 620 AMI events, respectively, corresponding to incidence rates of 4.1 and 6.6 per 10 000 person-years (crude HR: 0.63, 95% CI 0.60–0.66; Figure 1). After adjustment for potential confounders, the HR was 0.66 (95% CI 0.63–0.69). These risk estimates were consistent across age, sex, residence and income strata (Figure 2).

Among those who developed an AMI during the study period, there was a non-significant trend of lower in-hospital, 30-day or 1-year mortality amongst new immigrants (Table 2).

Discussion

The current study represented a large diverse population, and included approximately 4.2 million participants and over 15 000 AMI events. New immigrants had ~35% lower relative risk of AMI than matched long-term residents. This was so across various demographic strata and after adjusting for conventional risk factors for MI and for physician visits. Mortality rates among those who sustained an AMI were not significant, however.

Our study has several limitations. First, we used the date of enrollment in universal health insurance (OHIP) to approximate of the time of arrival to Ontario. Since most immigrants receive OHIP after ~3 months of achieving residency, this may not pose a major threat to validity. Had we misclassified the time of new receipt of OHIP, or had confused

Table 1 Characteristics of study participants

Characteristics[a]	New immigrants (n = 965 829)	Long-term residents (n = 3 272 393)
Measured at study entry		
Mean (SD) age, years	33.2 (10.1)	34.3 (10.9)
Age groups, years		
16–30	420 044 (43.5)	1 293 001 (39.5)
31–44	420 288 (43.5)	1 399 720 (42.8)
45–64	125 497 (13.0)	579 672 (17.7)
Females	480 719 (49.8)	1 625 688 (49.6)
Income quintile (Q)		
Q1 (lowest)	291 982 (30.8)	550 356 (16.9)
Q2	214 043 (22.6)	639 480 (19.6)
Q3	172 263 (18.2)	679 387 (20.8)
Q4	144 675 (15.2)	705 441 (21.6)
Q5 (highest)	126 241 (13.3)	690 706 (21.2)
Unknown	16 723 (1.7)	7126 (0.2)
Urban residence	923 158 (95.6)	2 916 033 (89.1)
After study entry		
Hypertension	130 718 (13.5)	601 921 (18.4)
Dyslipidaemia	155 112 (16.1)	532 418 (16.3)
Diabetes mellitus	74 273 (7.7)	257 625 (7.9)
Current smoking	1146 (0.12)	8920 (0.27)
Mean (SD) number of physician claims	35.7 (48.2)	46.5 (60.6)
Median (IQR) duration of follow-up, years	5.5 (2.8–8.5)	6.2 (3.6–9.0)

[a]Data are presented as a number (%) unless otherwise indicated.
SD: standard deviation; IQR: interquartile range.

new immigrants with long-term residents, then our effect sizes would likely have been attenuated. We did not have access to information on the study participants' lifestyle, ethnicity or country of birth, nor did we possess measures of blood pressure, blood glucose or lipid profile. Considering the data sources used in the study, it is also likely that comorbid conditions, such as smoking, were under-reported. We also lacked details about the pre-existing health of the new immigrants in our study. Canada's universal health-care system offers equal access to emergency care, especially for an acute and time-sensitive medical conditions such as AMI, so there was unlikely to be a difference in health-care access between the groups.

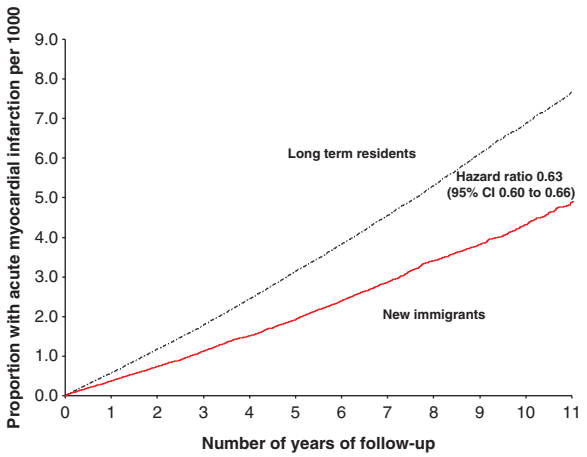

Figure 1. Risk of acute myocardial infarction comparing 965 829 new immigrants and 3 272 393 long-term residents in Ontario.

MARIO introduces precise, robust and representative estimates of the risk of AMI and AMI-associated mortality among new immigrants. In a study from Goteborg, Sweden of individuals in the age range of 25–64 years,[8] the incidence of AMI among immigrants was similar to that of Swedish-born participants. Studies of Japanese immigrants to North America found their prevalence of coronary heart disease to be 3–5 times higher than their counterparts who had retained their Japanese lifestyle.[9] Mortality due to cardiac disease was also higher in Japanese men living in California than those who remained in Japan.[10] Our current study differs from previous work because of its large sample size, the setting of a universal health-care system and the diversity of its population. Similar to native-born Americans, those born in Canada in the past 30 years represent an

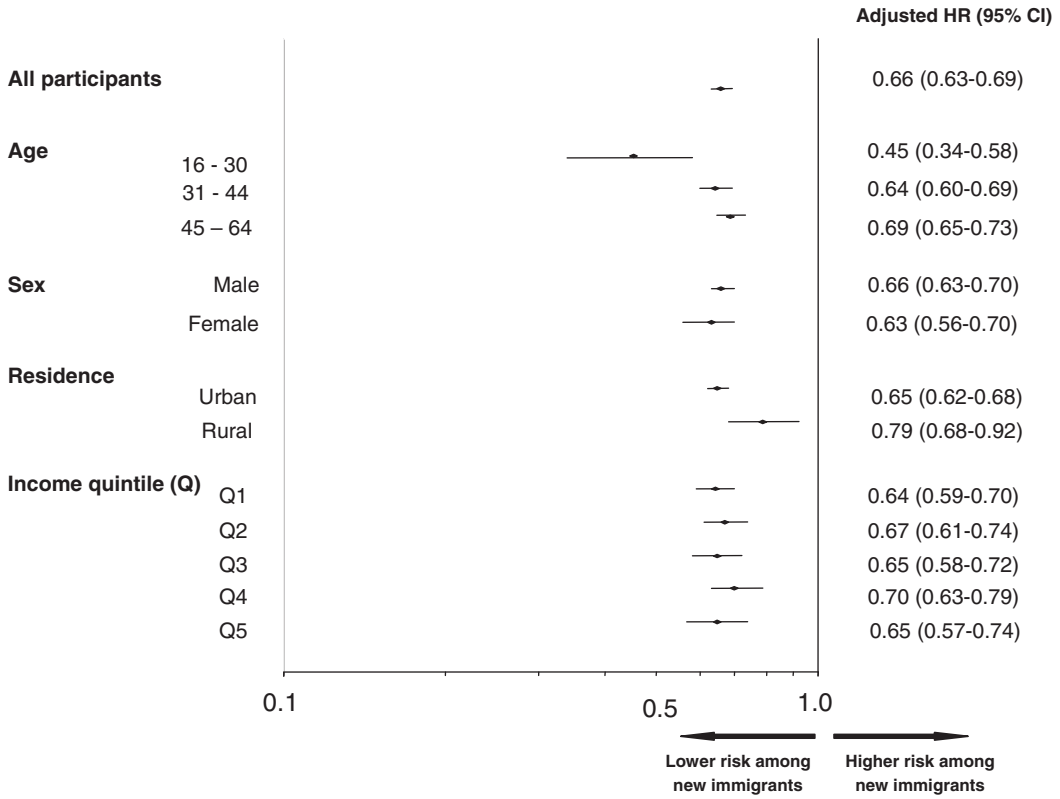

Figure 2. Risk of premature acute myocardial infarction according to participant characteristics at study entry comparing new immigrants and long-term residents. Adjusted HR (95% CI) adjusted for age (continuous in years), income quintile and urban vs. rural residence, each at study entry, as well as diagnosed hypertension, diabetes mellitus or smoking and number of physician claims, each after study entry.

Table 2 Risk of in-hospital, 30-day and 1-year mortality comparing new immigrants and long-term residents who developed acute myocardial infarction during the study period

Study outcome	No. (%)		Odds ratio(95% CI)	
	Recent immigrants ($n = 2290$)	Long-term residents ($n = 13\,620$)	Unadjusted	Adjusted[a]
Mortality				
In-hospital	51 (2.2)	367 (2.7)	0.82 (0.61–1.11)	0.79 (0.58–1.08)
30-day	67 (2.9)	493 (3.6)	0.80 (0.62–1.04)	0.78 (0.59–1.02)
1-year	106 (4.6)	755 (5.5)	0.83 (0.67–1.02)	0.82 (0.66–1.03)

[a]Adjusted for age (continuous in years), income quintile and urban vs. rural residence, each at study entry, as well as diagnosed hypertension, diabetes mellitus or smoking and number of physician claims, each after study entry.

ethnically diverse group of people, as do its new immigrants.[5]

The results of MARIO constitute an early step in our understanding of the 'healthy immigrant' effect in relation to acute coronary artery disease. In Canada, the USA and other Western nations, many recent immigrants originate from South and East Asia, where the rates of obesity, hypertension and diabetes mellitus are typically lower.[11,12] The tendency for young immigrants to have lower rates of chronic diseases than those born in their host country may reflect the fact that the most robust individuals choose to immigrate. Furthermore, a required medical examination of all prospective immigrants may screen out the most unhealthy applicants with chronic disease.[13]

Our novel findings suggest the presence of a 'healthy immigrant effect' in relation to AMI.[2] Accordingly, policies may be needed that aim to preserve the healthier state of new immigrants, while continuing to focus on lowering cardiovascular risk among all adults.[14,15]

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Appendix 1

World region of origin of new immigrants to Ontario, 2001–06[a]

Region	Number (%)
Asia	375 225 (64.6)
Europe	84 590 (14.6)
Africa	40 320 (6.9)
Central/South America	39 705 (6.8)
Caribbean	20 105 (3.5)
North America	18 310 (3.2)
Oceania/Other	2490 (0.4)

Modified from: Ontario Ministry of Finance. http://www.fin.gov.on.ca/english/economy/demographics/census/cenhi06-7.html. Accessed 16 September 2009.

[a]The country of origin of most immigrants to Ontario between 2001 and 2006 included India (15%), China (14%), Pakistan (7.5%), the Philippines (6.5%) and Sri Lanka (3.2%).

AMI: acute myocardial infarction; OHIP: Ontario health Insurance Plan