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# All-cause acute care hospitalization rates of immigrants and the Canadian-born population: A linkage study

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## ABSTRACT

### Background

As Canadian immigration levels increase, knowledge concerning immigrant health becomes increasingly important for health system policy and planning. This study compares the rate of all-cause hospitalization among immigrants with that of their Canadian-born counterparts.

### Data and methods

Using records from the Discharge Abstract Database (2004/2005 to 2016/2017) and the Ontario Mental Health Reporting System (2006/2007 to 2017/2018) linked to the 2016 Longitudinal Immigration Database, this study compared the age-standardized hospitalization rates (ASHRs) among immigrants with those of the Canadian-born population; the latter were obtained from a linkage based on the 2011 National Household Survey. Comparisons were made at the International Classification of Diseases chapter level by immigrant landing year, admission category and world region of birth. Quebec data were not available.

### Results

Overall, ASHRs among immigrants were lower than for the Canadian-born population. Immigrants in the economic class had the lowest ASHR, followed by those in the family class and among refugees. After pregnancy was excluded, leading hospitalization causes were similar for immigrants and the Canadian-born population, where top causes included digestive system and circulatory diseases, injuries, and cancer. In male and female immigrants, the ASHRs were lowest among those from East Asia. By landing year, males arriving earlier had the highest ASHR compared with the most recent arrivals. When pregnancy was excluded and while the differential in ASHRs among females by landing year remained, the magnitude was smaller.

### Interpretation

These results corroborate those from previous studies suggesting a healthy immigrant effect, but also reveal heterogeneity in ASHRs within the immigrant population. They provide a baseline for comparison of health status between populations, which enables further monitoring and informs health-system policy and planning.

### Keywords

Immigrant health, immigrant admission characteristics, hospitalization, data linkage, disease classification

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### ***What is already known on this subject?***

- Previous studies have observed a healthy immigrant effect, where immigrants typically arrive in good health, compared with their Canadian-born counterparts, but their health status declines over time. Furthermore, health status has been associated with immigrant admission characteristics and world region of origin.
- Using the Longitudinal Immigration Database linked to hospitalization data (excluding Quebec), previous studies had analyzed leading causes of hospitalization among immigrants to Canada by immigrant-related covariates. However, these earlier studies did not compare hospitalization rates between immigrants and the Canadian-born population, and there is a need to incorporate previously missing mental health data from Ontario with these comparisons.

### ***What does this study add?***

- While the results suggest a healthy immigrant effect, heterogeneity in hospitalization rates within the immigrant population is observed. The overall age-standardized hospitalization rates (ASHRs) among immigrants were lower than those of the Canadian-born population. Among immigrants, ASHRs were lowest in the economic class, followed by the family class and among refugees. The ASHRs were lowest among immigrants from East Asia.
- By landing year, males arriving earlier had the highest ASHR, compared with the most recent arrivals. Excluding pregnancy, a similar but weaker differential in ASHRs among females by landing year was observed. While differences in the leading causes of hospitalization exist between sex, circulatory disorders and digestive disorders ranked highly and were similar for immigrants and the Canadian-born population. Mental health ranked as the fifth and sixth leading causes of hospitalization among males and females (excluding pregnancy), respectively.
- Increased understanding of both the patterns and the determinants of immigrant health outcomes supports health policy making and improving continuity of care and settlement in Canada.

In 2019, approximately 340,000 immigrants became permanent residents in Canada, with the numbers expected to reach more than 400,000 per year by 2023.<sup>1</sup> The Canadian government accords high priority to the health of immigrants, given the importance of health in successful integration and economic productivity. As part of Immigration, Refugees and Citizenship Canada's (IRCC) health screening requirements, all permanent residence applicants must undergo an immigration medical examination. For admissibility purposes, Canada medically screens immigrants for selected diseases that pose a threat to public health (e.g., tuberculosis) or public safety, as well as to mitigate the impact on Canadian health or social services.<sup>2</sup>

Research on the health status of immigrants and their utilization of health services is instrumental for health policy and strategic health care planning. Previous studies have described a healthy immigrant effect (HIE) in this population; immigrants typically arrive in good health compared with their Canadian-born counterparts, but their health status declines over time.<sup>3-9</sup> Furthermore, health status has been associated with immigrant admission characteristics and world region of origin.<sup>10</sup>

Data on hospitalization can serve as an indicator of health among immigrants. Using immigrant landing administrative data linked to health care data, leading causes of hospitalization can be assessed in a large cohort that also allows for the analysis of immigrant-related covariates. This approach was used in an

earlier study based on immigration and health care datasets from 2006 to 2008.<sup>11</sup> However, this previous study did not directly compare hospitalization rates between immigrants and the Canadian-born population, and it did not incorporate mental health data from Ontario.<sup>11</sup> In light of increasing Canadian immigration levels,<sup>1</sup> an updated analysis of hospitalization patterns among immigrants to Canada, relative to the Canadian-born population, is needed to inform health care system policy and planning. This descriptive study aims to examine hospitalization rates and leading causes of hospitalization, including mental health in immigrants and the Canadian-born population, stratified by sex and selected immigration characteristics.

## **Data and methods**

### **Data linkage**

Similar to previous work,<sup>12</sup> the Longitudinal Immigration Database (IMDB) was linked to the hospital Discharge Abstract Database (DAD) at Statistics Canada (StatCan) using the Social Data Linkage Environment (SDLE) and its highly secured central depository called the Derived Record Depository (DRD).<sup>13</sup> In addition, discharge-related records from the Ontario Mental Health Reporting System (OMHRS) were also linked in the SDLE to account for discharges from mental health institutions and psychiatric facilities in the province of Ontario,

**Table 1**  
**Descriptive characteristics of the study cohort, separately for the Canadian-born population and immigrant cohort, by sex**

	Canadian-born population (weighted)		IMDB immigrant cohort (1980 to 2011)	
	Males (n=9,456,690)	Females (n=9,580,695)	Males (n=1,990,725)	Females (n=2,171,280)
	percent			
<b>Age group</b>				
0 to 17	26.6	24.7	10.7	9.3
18 to 39	29.5	28.7	35.4	37.1
40 to 64	33.2	34.0	46.2	44.5
65 and older	10.8	12.6	7.6	9.1
<b>Immigration landing year</b>				
1980 to 1989	...	...	16.9	16.4
1990 to 2002	...	...	45.6	45.9
2003 to 2011	...	...	37.5	37.6
<b>Source world region</b>				
United States	...	...	2.6	2.9
The Caribbean and Central and South America	...	...	9.8	10.5
Western Europe	...	...	7.5	6.6
Eastern Europe	...	...	10.6	10.8
Sub-Saharan Africa	...	...	5.5	5.1
Southwest Asia, Middle East and North Africa	...	...	10.9	9.1
South Asia	...	...	23.2	21.8
Southeast Asia	...	...	8.9	11.0
East Asia	...	...	19.9	21.3
Others	...	...	1.2	1.1
<b>Immigrant admission category</b>				
<b>Economic</b>	...	...	53.9	48.8
Principal applicants	...	...	28.3	13.5
Spouse and dependants	...	...	25.6	35.2
<b>Family</b>	...	...	28.2	37.5
Parents and grandparents	...	...	9.2	11.1
Spouse and dependants	...	...	18.3	25.7
<b>Refugee</b>	...	...	16.7	12.5
<b>Resettled</b>				
Government assisted	...	...	3.6	1.1
Privately sponsored	...	...	3.4	1.2
Dependants of resettled refugees	...	...	3.9	5.7
<b>Protected persons</b>				
In-Canada refugees	...	...	4.6	3.3
Dependants of protected persons	...	...	1.1	1.2
<b>Others</b>	...	...	1.3	1.3

... not applicable

**Notes:** IMDB = Longitudinal Immigration Database. NHS = National Household Survey. DAD = Discharge Abstract Database. OMHRS = Ontario Mental Health Reporting System. Subtotals may not add up to the total because of miscellaneous subgroups.

**Sources:** 2011 NHS-DAD-OMHRS linked data and 1980-to-2016 IMDB-DAD-OMHRS linked database.

which have been captured solely in the OMHRS (and not in the DAD) since fiscal year 2006/2007. Mental health hospitalizations from all other provinces were included in the DAD. Also, the 2011 Canadian Census Health and Environment Cohort (CanCHEC) provided the Canadian-born comparison group for the IMDB-based results. These linkages were approved by StatCan’s senior management,<sup>14</sup> and use of the de-identified linked data is governed by the Directive on Record Linkage.<sup>15</sup>

The IMDB is a research database representing unduplicated immigrant records derived from the Immigrant Landing File. The IMDB contains administrative information for all individuals who have landed in Canada since 1980, with data provided to StatCan monthly by IRCC.<sup>16</sup> In the present study, landing records and temporary resident permits from 1980 to 2017 were eligible for linkage (n=12,317,708). Using probabilistic methods, the IMDB was linked to the DRD (linkage rate of 90%, n=11,036,264).<sup>17</sup>

The DAD contains demographic, administrative and clinical data for all acute-care and some psychiatric, chronic rehabilitation and day-surgery discharges for all provinces and territories, excluding Quebec.<sup>18</sup> Data are provided to StatCan annually by the Canadian Institute for Health Information (CIHI) for each fiscal year. Hospital discharges that occurred between April 1, 1994, and March 31, 2017, were eligible for linkage from 84.8 million hospital discharge records. The linkage used a deterministic approach, yielding a linkage rate of 91%.<sup>19</sup>

The OMHRS is a CIHI database that includes information about all individuals admitted to designated inpatient mental health beds in general and specialty facilities in Ontario since 2006/2007.<sup>20</sup> CIHI provides OMHRS data to StatCan annually. The OMHRS includes information at the assessment level about patients’ mental and physical health, social supports, and service use. Mental health assessment records covering the period from April 1, 2006, to March 31, 2018, were eligible for

**Table 2**  
Hospitalization events from May 10, 2011, to May 9, 2016, by ICD-10-CA chapter among IMDB immigrants (1980 to 2011) compared with NHS Canadian-born (excluding Quebec)

ICD-10-CA chapters	NHS						IMDB					
	Canadian-born population (weighted)						IMDB immigrants (landing 1980 to 2011)					
	Males (n=2,765,450)		Females (n=3,867,455)		Females, excluding pregnancy and childbirth (n=2,906,850)		Males (n=328,215)		Females (n=643,050)		Females, excluding pregnancy and childbirth (n=350,320)	
	percent	rank	percent	rank	percent	rank	percent	rank	percent	rank	percent	rank
I - Infectious/parasitic	2.8	...	2.2	...	3.0	...	3.2	...	1.7	...	3.1	...
II - Neoplasms	7.5	...	6.2	...	8.2	...	8.6	4	7.4	2	13.6	1
III - Blood and immune system	1.1	...	0.9	...	1.2	...	1.2	...	0.9	...	1.6	...
IV - Endocrine and metabolic	3.0	...	2.8	...	3.8	...	2.9	...	2.0	...	3.6	...
V - Mental	7.3	...	5.8	...	7.7	...	8.5	...	4.0	...	7.2	...
VI - Nervous	2.1	...	1.4	...	1.9	...	1.9	...	0.9	...	1.6	...
VII - Eye and adnexa	0.3	...	0.2	...	0.3	...	0.3	...	0.1	...	0.2	...
VIII - Ear and mastoid	0.3	...	0.2	...	0.3	...	0.3	...	0.2	...	0.4	...
IX - Circulatory	15.6	1	7.9	3	10.5	2	16.9	1	6.0	4	11.0	3
X - Respiratory	9.5	4	6.6	...	8.8	...	7.5	...	3.4	...	6.2	...
XI - Digestive	12.9	2	9.5	2	12.6	1	15.2	2	7.1	3	13.0	2
XII - Skin	1.3	...	0.9	...	1.1	...	0.8	...	0.4	...	0.7	...
XIII - Musculoskeletal	7.6	...	6.6	...	8.8	4	5.2	...	3.8	...	7.0	...
XIV - Genitourinary	5.3	...	6.4	...	8.5	...	6.7	...	5.4	...	9.9	4
XV - Childbirth	0.1 <sup>††</sup>	...	22.4	1	...	...	0.1 <sup>††</sup>	...	42.6	1	...	...
XVI - Perinatal	0.1 <sup>††</sup>	...	0.2	...	0.2	...	0.0 <sup>††</sup>	...	0.1	...	0.1	...
XVII - Congenital malformations	0.4	...	0.3	...	0.4	...	0.3	...	0.2	...	0.3	...
XVIII - Abnormal clinical and lab findings	6.6	...	5.5	...	7.2	...	6.9	...	3.9	...	7.2	...
XIX - Injury	9.8	3	7.0	4	9.3	3	8.9	3	4.3	...	7.9	...
XXI - Factors influencing health status contact and health services	6.6	...	6.8	...	6.4	...	4.9	...	5.8	...	5.2	...
...	not applicable											

<sup>††</sup> Small number of pregnancy-related or perinatal-related hospitalizations listed here probably related to sex change, coding issue or record linkage mismatch.

**Notes:** ICD-10-CA = International Classification of Diseases and Related Health Problems, Canada, 10th edition. IMDB = Longitudinal Immigration Database. NHS = National Household Survey. DAD = Discharge Abstract Database. OMHRS = Ontario Mental Health Reporting System.

**Sources:** 2011 NHS-DAD-OMHRS linked data and 1980-to-2016 IMDB-DAD-OMHRS linked database.

linkage to the DRD in the present study (n=1,248,844). The linkage used a deterministic approach (linkage rate of 82.7%).<sup>21</sup>

Finally, the 2011 CanCHEC, a population-based study cohort based on the 2011 National Household Survey (NHS), was probabilistically linked with the DAD<sup>22</sup> and the OMHRS through the SDLE. Together these linkages provide the corresponding hospitalization data among the Canadian-born cohort (the 2011 NHS-DAD-OMHRS linked data), while the IMDB was linked to hospitalization data for the immigrant cohort (the 1980 IMDB-DAD-OMHRS linked database). The NHS was probabilistically linked to the DRD with a linkage rate of 96.7% (n=6,499,185).<sup>22</sup>

**Study cohorts**

The present study included two cohorts: an immigrant cohort and a Canadian-born cohort. The immigrant cohort was based on the IMDB and was limited to immigrants who arrived in Canada between January 1, 1980, and May 10, 2011. Immigrants in this study were limited to permanent residents, so temporary residents (e.g., students, workers, visitors) were excluded. Permanent residents include both economic and family-class immigrants, as well as refugees. Immigrants with a death recorded as occurring prior to May 10, 2011, on the IMDB (as per a previous linkage with the Canadian Vital Statistics Death Database) were removed from the IMDB immigrant study cohort.

In contrast to previous linkages that merged the IMDB with hospital discharges through the 2006 Census, which has been previously linked to both databases independently,<sup>23</sup> the current linkage did not use such a bridge file, making it susceptible to including immigrants who were no longer in Canada after landing. Without the removal of these emigrants from the analysis, the derived hospitalization rates would be underestimated. In the present study, tax files that are part of the IMDB were used as a proxy for emigration. Individuals who did not file taxes in both 2010 and 2011 were assumed to have emigrated. The exceptions were new immigrants who arrived during those two years, as well as children and youth younger than 19 (as of May 10, 2011), who may not have needed to file taxes. This resulted in 17% of male and 18% of female IMDB immigrants being identified as emigrants and, therefore, excluded from the study cohort. Lastly, to account for the fact that Quebec does not contribute data to the DAD, immigrants to Quebec were removed from the cohort. The final number of individuals in the immigrant cohort was 4,162,005.

The Canadian-born cohort was composed of respondents in the 2011 CanCHEC who self-identified as being Canadian-born. To account for the fact that Quebec does not contribute data to the DAD, 2011 CanCHEC members who resided in Quebec were excluded from the analysis. The final sample size of the Canadian-born cohort was 3,754,230, representing a weighted population of 19,037,385.

**Table 3**  
Overall crude and age-standardized acute-care hospitalization rates<sup>††</sup> (ASHRs, per 10,000 population) for IMDB immigrants by sex and by selected immigrant characteristics, compared with overall Canadian-born population (excluding Quebec)

	Males				Females				Females, excluding pregnancy and childbirth			
	Crude rate	95% confidence interval			Crude rate	95% confidence interval			Crude rate	95% confidence interval		
		ASHR	from	to		ASHR	from	to		ASHR	from	to
NHS Canadian-born population (weighted)	608	646	641	652	832	826	821	831	629	622	617	627
1980-to-2011 IMDB immigrants	332	358	356	361	596	545	543	547	325	331	329	333
<b>Immigrant admission category</b>												
<b>Economic</b>	231	281	278	284	432	433	430	437	219	261	257	264
Principal applicants	301	283	273	294	508	523	504	541	285	280	265	294
Spouse and dependants	154	264	257	271	403	403	399	407	193	247	243	251
<b>Family</b>	478	409	405	414	778	620	616	624	442	361	357	365
Parents and grandparents	838	425	404	446	1,005	662	638	685	876	392	371	413
Spouse and dependants	311	393	385	400	680	579	573	585	263	321	315	327
<b>Refugee</b>	394	442	435	450	673	643	635	651	363	402	394	409
<b>Resettled</b>												
Government assisted	524	480	437	524	728	792	741	843	485	456	417	494
Privately sponsored	514	470	377	564	635	798	636	960	447	452	330	573
Dependants of resettled refugees	229	411	378	445	661	621	609	632	328	381	370	392
<b>Protected persons</b>												
In-Canada refugees	381	465	449	481	703	657	642	673	398	436	421	451
Dependants of protected persons	238	434	388	480	640	590	558	622	238	343	312	374
<b>Others</b>	576	442	398	485	774	611	585	638	579	388	364	412
<b>Immigration landing year</b>												
1980 to 1989	558	400	396	405	670	554	549	559	545	369	364	373
1990 to 2002	352	359	355	362	529	487	484	491	341	327	324	330
2003 to 2011	206	279	275	283	645	538	534	542	209	268	264	271
<b>Source world region</b>												
United States	354	421	406	436	577	624	608	639	374	417	402	431
Caribbean and Central and South America	375	426	416	435	720	666	657	674	435	433	426	441
Western Europe	418	423	415	431	645	626	617	635	432	415	406	423
Eastern Europe	400	429	420	438	606	556	549	564	354	355	348	362
Sub-Saharan Africa	352	443	429	458	802	719	706	732	362	419	407	431
Southwest Asia, Middle East and North Africa	313	370	363	378	622	572	564	580	302	352	345	359
South Asia	361	376	371	380	655	564	560	569	329	339	335	343
Southeast Asia	291	351	343	359	568	539	533	546	304	314	308	320
East Asia	220	223	219	227	405	375	372	379	216	208	205	212

<sup>††</sup> Standardization used the overall NHS population outside Quebec as the reference population.

Notes: ASHR = Age-standardized hospitalization rate. IMDB = Longitudinal Immigration Database. NHS = National Household Survey. DAD = Discharge Abstract Database. OMHRS = Ontario Mental Health Reporting System.

Sources: 2011 NHS-DAD-OMHRS linked data and 1980-to-2016 IMDB-DAD-OMHRS linked database.

Hospitalization records from the DAD and the OMHRS were linked to the immigrant and Canadian-born cohorts for a five-year follow-up period, starting from Census Day 2011 (May 10, 2011) through to May 9, 2016. Hospitalization rates for immigrants arriving between 1980 and 2011 based on the NHS–DAD and the NHS–OMHRS were compared with the rates based on the IMDB–DAD and the IMDB–OMHRS for the same period to validate the use of tax filing patterns as a proxy for emigration. They were found to be similar (data not shown).

### Hospital discharges by cause

The primary outcome measure in this study was an acute-care hospital discharge occurring during the five-year study period. Discharges were classified according to the diagnosis or condition most responsible for the patient’s stay in hospital.<sup>24</sup> Diagnoses were coded using the 10th edition of the *International Classification of Diseases and Related Health Problems, Canada* (ICD-10-CA), and these were subdivided according to their chapter code. As the OMHRS employs a mental health disease classification system other than ICD-10-CA, all OMHRS records that were linked to the study cohorts were classified as Chapter 5, i.e., mental and behavioural

disorders. Hospitalizations related to pregnancy were considered as discharges with a most responsible diagnosis in Chapter 19 of ICD-10-CA, or those coded as Z34-Z39, which include supervision of normal and high-risk delivery, and postpartum care and examination. To avoid overestimation of discharges related to hospital transfers, hospital admissions within one day of a previous discharge for the same patient were consolidated into a single hospitalization episode. In these cases, the most responsible diagnosis for the last hospital discharge within the episode was used to characterize the nature of the hospitalization.

### Stratification variables

Age and sex were determined for the immigrant cohort and the Canadian-born cohort based on the IMDB and the CanCHEC, respectively. For the Canadian-born cohort, age was calculated as of May 10, 2011. Among immigrants, age was calculated as the difference between 2011 and the birth year obtained from the IMDB. Age was subsequently grouped as 0 to 17, 18 to 39, 40 to 64, and 65 and older.

Immigrant characteristics, including landing year, country of birth and admission class, were obtained from the IMDB.

Table 4

Leading disease-specific crude and age-standardized acute-care hospitalization rates<sup>‡</sup> (ASHRs, per 10,000 population) among males by selected characteristics, for IMDB immigrants, compared with overall Canadian-born population (excluding Quebec)

	Circulatory disease (Rank #1)				Digestive disease (Rank #2)				Injury (Rank #3)				Cancer (Rank #4)			
	Crude rate	95% confidence interval			Crude rate	95% confidence interval			Crude rate	95% confidence interval			Crude rate	95% confidence interval		
		ASHR	from	to		ASHR	from	to		ASHR	from	to		ASHR	from	to
NHS Canadian-born population (weighted)	94.7	103.8	102.3	105.2	78.4	82.1	80.9	83.4	59.3	61.5	60.6	62.4	45.3	49.1	48.2	50.1
1980-to-2011 IMDB immigrants	56.0	60.8	60.1	61.5	50.4	50.8	50.2	51.4	29.4	30.9	30.4	31.3	28.4	29.5	29.1	30.0
<b>Immigrant admission category</b>																
<b>Economic</b>	38.2	48.0	46.9	49.0	39.2	42.7	41.8	43.6	21.3	24.5	23.9	25.1	23.1	28.6	27.8	29.4
Principal applicants	59.1	49.7	48.0	51.4	48.6	46.6	42.1	51.1	23.7	22.7	19.9	25.5	34.5	29.2	27.7	30.7
Spouse and dependants	15.2	42.6	40.1	45.0	28.7	41.2	39.2	43.3	18.6	25.0	23.5	26.5	10.6	27.0	25.1	29.0
<b>Family</b>	83.0	66.6	65.5	67.8	65.3	56.4	55.1	57.7	39.1	35.0	34.0	36.0	36.0	29.2	28.5	30.0
Parents and grandparents	165.3	70.3	68.6	72.1	96.2	58.3	53.0	63.6	55.0	34.1	29.5	38.8	62.4	28.3	27.1	29.4
Spouse and dependants	44.8	63.4	60.8	66.0	50.8	56.0	53.8	58.1	31.7	34.8	33.3	36.3	23.9	31.6	30.1	33.2
<b>Refugee</b>	65.2	75.8	73.3	78.3	60.0	61.4	59.4	63.4	37.7	41.1	39.7	42.6	31.7	34.5	33.0	36.1
<b>Resettled</b>																
Government assisted	95.4	71.1	67.0	75.1	79.0	61.2	54.9	67.4	42.2	47.0	35.6	58.4	50.4	36.2	33.6	38.9
Privately sponsored	107.5	79.6	75.2	84.0	72.7	53.3	49.7	57.0	41.1	31.1	28.7	33.4	50.6	35.2	32.6	37.8
Dependants of resettled refugees	16.1	67.6	53.5	81.8	37.9	52.6	46.0	59.2	34.0	42.8	36.8	48.8	10.9	32.9	25.3	40.5
<b>Protected persons</b>																
In-Canada refugees	61.9	83.3	77.7	89.0	58.8	63.3	58.9	67.7	36.8	41.5	38.6	44.5	25.5	31.7	28.6	34.8
Dependants of protected persons	22.8	75.6	59.8	91.5	40.8	73.8	56.8	90.9	29.0	34.7	28.5	40.8	11.2	30.9	21.6	40.2
<b>Others</b>	98.9	63.2	58.4	68.1	70.6	55.7	49.7	61.6	49.3	41.4	36.2	46.6	45.2	30.0	26.6	33.4
<b>Immigration landing year</b>																
1980 to 1989	105.6	73.2	71.7	74.7	75.4	52.9	51.6	54.2	44.0	32.4	31.5	33.3	52.4	35.6	34.7	36.6
1990 to 2002	60.3	59.8	58.8	60.9	52.9	51.0	50.0	52.0	30.2	30.9	30.1	31.6	30.0	28.6	27.9	29.3
2003 to 2011	28.8	47.5	46.2	48.9	36.1	42.3	41.3	43.4	21.8	25.2	24.4	25.9	15.9	23.6	22.8	24.5
<b>Source world region</b>																
United States	51.5	65.9	61.3	70.4	49.8	55.9	51.7	60.0	34.9	39.0	36.0	42.0	26.2	32.0	28.9	35.1
Caribbean and Central and South America	60.2	72.1	69.1	75.1	58.6	60.3	57.9	62.8	33.9	36.1	34.4	37.9	28.7	30.5	28.9	32.1
Western Europe	66.8	67.4	64.7	70.1	61.2	58.9	56.5	61.3	42.0	42.6	40.8	44.4	39.0	37.9	36.0	39.7
Eastern Europe	75.7	82.7	79.9	85.6	60.9	59.7	57.4	62.0	39.3	40.2	38.1	42.2	41.4	43.3	41.4	45.2
Sub-Saharan Africa	47.0	65.7	61.5	69.9	48.4	55.6	52.3	58.9	35.6	42.3	39.6	44.9	25.6	31.5	28.9	34.1
Southwest Asia, Middle East and North Africa	50.8	65.3	62.6	68.0	50.2	54.7	52.5	56.9	29.3	32.4	31.0	33.8	23.9	28.6	27.1	30.1
South Asia	69.8	72.1	70.5	73.6	52.1	50.9	49.6	52.3	28.0	29.0	28.1	29.8	22.6	22.7	21.8	23.6
Southeast Asia	50.3	61.5	58.9	64.0	51.0	55.3	53.0	57.6	21.7	24.8	23.4	26.1	28.5	32.6	30.8	34.4
East Asia	29.6	28.8	27.9	29.8	34.3	34.0	32.9	35.1	19.0	19.3	18.6	20.1	28.1	26.2	25.3	27.1

<sup>‡</sup> Standardization used the overall NHS population outside Quebec as the reference population; leading causes ranked for the immigrant population.

Notes: ASHR = Age-standardized hospitalization rate. IMDB = Longitudinal Immigration Database. NHS = National Household Survey. DAD = Discharge Abstract Database. OMHRS = Ontario Mental Health Reporting System.

Sources: 2011 NHS-DAD-OMHRS linked data and 1980-to-2016 IMDB-DAD-OMHRS linked database.

Landing year was grouped as 1980 to 1989, 1990 to 2002 and 2003 to 2011 to align with corresponding changes in immigration policy.<sup>25</sup> Immigrant birth countries were grouped into 10 world regions: the United States, the Caribbean and Central and South America, Western Europe, Eastern Europe, Sub-Saharan Africa, Southwest Asia and North Africa, South Asia, Southeast Asia, East Asia, and others. Immigrant admission classes were classified into four general groups: economic class (including principal applicants, and spouses and dependants), family class (subdivided into parents and grandparents, and spouses and dependants), refugees (composed of resettled refugees and protected persons) and others. Resettled refugees were further classified as government assisted, privately sponsored and dependants; protected persons include in-Canada protected persons and their dependants.

### Statistical methods

Descriptive statistics are presented to characterize the immigrant and Canadian-born cohorts. Crude rates and age-standardized hospitalization rates (ASHRs) were derived by sex for overall hospitalization (with and without pregnancy) and for the top four leading causes (ranked by distribution, excluding pregnancy for women). These rates were also stratified by the

variables identified above (immigrant admission class, landing year and world region). The Canadian-born population (excluding Quebec) from the 2011 NHS was used as the reference population for standardization. Rate derivation was adjusted for individuals who died during follow-up. Lastly, to account for the 2011 NHS complex survey design and to adjust for linkage, estimates for the Canadian-born cohort were calculated using sample and bootstrap weights.<sup>22</sup> No weighting adjustment was used for the immigrant cohort, as the cohort is considered to be a census of immigrants.

### Results

The characteristics of the immigrant and Canadian-born populations are shown in Table 1, with immigrants comprising 18% of the overall weighted study cohort. Almost half of the immigrants in the study cohort were aged 40 to 64 years, and almost half arrived in Canada between 1990 and 2002. More than half of immigrants were from South, Southeast and East Asia, with the top source countries being China, India and the Philippines (detailed country-level data not shown). The highest percentage of immigrants were admitted as economic-class applicants, followed by the family class.



Table 2 shows the distribution of hospital events classified by ICD-10-CA chapters among immigrants, compared with the Canadian-born cohort, stratified by sex, with and without pregnancy-related discharges. The highest percentages of hospital events among immigrant males were for circulatory conditions (17%), digestive disorders (15%), injuries (9%), and neoplasms (9%); as a whole, they contributed to 50% of all hospitalizations among these males. This ranking was similar for Canadian-born males, with the exception of respiratory diseases (10%), which ranked fourth in the Canadian-born cohort. For female immigrants, the highest percentages of hospital events, excluding pregnancies and childbirth, were neoplasms (14%), digestive disorders (13%), circulatory conditions (11%) and genitourinary conditions (10%), which together comprised close to 50% of all hospitalizations among females, excluding pregnancy. The ranking of health conditions for Canadian-born females was slightly different, with digestive disorders (13%), circulatory conditions (11%), injuries (9%) and musculoskeletal disorders (9%) ranked as the top four conditions for hospitalization. Combined, these conditions accounted for 42% of all Canadian-born female hospitalizations, excluding pregnancy. Pregnancy accounted for 43% of all female hospitalizations among immigrants, compared with 23% among Canadian-born females.

Immigrants had almost half the overall crude rates and ASHRs of the Canadian-born population in both males and females when excluding pregnancy and childbirth (Table 3). The ASHR for Canadian-born males was 646 per 10,000 population (95% confidence interval [CI]=641 to 652), compared with 358 among immigrant males (95% CI=356 to 361). Similarly, the ASHR for Canadian-born females, excluding pregnancy, was 622 per 10,000 population (95% CI=617 to 627), compared with 331 among immigrant females (95% CI=329 to 333). The crude rates and ASHRs for immigrants were lowest in the economic class, followed by the family class and refugees for both males and females. The ASHRs were lowest for immigrants who landed in more recent years, and they increased with time spent in Canada to approach those of the Canadian-born population. For example, among males, the ASHR increased from 279 (95% CI=275 to 283) among those who landed between 2003 and 2011 to 400 (95% CI=396 to 405) among immigrants who landed between 1980 and 1989. For females, the effect of time since landing on the ASHR was observed only when pregnancy-related hospitalizations were excluded from ASHR calculations. For both males and females, the ASHR of immigrants was lowest among those from East Asia.

The four leading disease-specific crude rates and ASHRs for male immigrants compared with Canadian-born males are shown in Table 4. Male refugees had the highest ASHRs for circulatory conditions and, to a lesser extent, digestive conditions. Similar to the overall hospitalization rates, the hospitalization rates for the top four conditions in male immigrants were lowest for recent arrivals and highest among more established immigrants, where ASHRs began to approach the rates for the Canadian-born population. Results by world

region of birth show that Eastern European males had the highest rates for circulatory conditions (82.7; 95% CI=72.9 to 85.6) and cancers (43.3, 95% CI=41.4 to 45.2) among immigrants, while East Asian males had the lowest digestive disease, injury and circulatory disease rates.

Table 5 shows the four leading disease-specific crude rates and ASHRs for female immigrants (excluding pregnancy) compared with Canadian-born females. Female refugees had the highest ASHRs for all four leading conditions. Similar to the overall hospitalization rates, the ASHRs for the four top conditions in female immigrants were lowest for those who landed in more recent years and increased with time spent in Canada, approaching the rates for the Canadian-born population. The ASHRs were consistently high for females from the Caribbean and Central and South America for all four leading conditions, while those for females from East Asia were consistently low.

## Discussion

This study found lower rates of hospitalization among male and female immigrants, compared with Canadian-born individuals. Among immigrants, the lowest rates of hospitalization were seen among those who had arrived in Canada more recently, who were part of the economic class and whose country of origin was in East Asia. The health of immigrants is influenced by a number of factors, such as the conditions in their original home country, why and when they migrated, and their experiences after arrival in Canada.<sup>26</sup> The results of this study concerning hospitalization rates among groups of immigrants, compared with their Canadian-born counterparts, can inform health screening policy and strategic health care planning for immigrants to Canada.

Similar to previous work,<sup>3-9</sup> results from this study support the existence of a HIE, as immigrants have almost half the overall ASHR compared with Canadian-born males and females, excluding hospitalizations related to pregnancy and childbirth. In addition, similar to a previous study using the IMDB-DAD linkage,<sup>11</sup> non-pregnancy-related ASHRs were lowest among the most recently arrived immigrants, providing support to previous studies<sup>5,11</sup> that suggest that the magnitude of the HIE may decrease over time. The top four causes of non-pregnancy-related hospitalization were circulatory disease, digestive disease, injury and cancer among males, and cancer, digestive disease, circulatory disease and genitourinary conditions among females. These causes of hospitalization were similar to those found in the previous IMDB-DAD study,<sup>11</sup> with the exception that among females in this study, genitourinary conditions (ICD-10-CA Chapter 14) replaced injury as the fourth leading cause of hospitalization, while injury ranked fifth in the current study.

Economic-class immigrants, composed of skilled workers and other professionals, had the lowest ASHRs, followed by family-class immigrants and refugees. There are several selection factors that may be associated with better health status among

Table 5

Leading disease-specific crude and age-standardized acute-care hospitalization rates<sup>†</sup> (ASHRs, per 10,000 population) among females, excluding pregnancy, by selected characteristics, for IMDB immigrants, compared with overall Canadian-born population (excluding Quebec)

	Cancer (Rank #1)				Digestive disease (Rank #2)				Circulatory disease (Rank #3)				Genitourinary conditions (Rank #4)			
	Crude rate	95% confidence interval			Crude rate	95% confidence interval			Crude rate	95% confidence interval			Crude rate	95% confidence interval		
		ASHR	from	to		ASHR	from	to		ASHR	from	to		ASHR	from	to
NHS Canadian-born population (weighted)	51.3	50.6	49.8	51.3	79.0	78.3	77.1	79.6	66.0	64.9	63.8	66.1	53.6	53.1	52.3	53.9
1980-to-2011 IMDB immigrants	44.2	38.9	38.4	39.3	42.3	41.9	41.4	42.4	35.6	39.8	39.3	40.4	32.1	29.7	29.3	30.1
<b>Immigrant admission category</b>																
<b>Economic</b>	38.8	38.0	37.2	38.8	31.8	35.3	34.4	36.2	15.9	25.3	24.3	26.2	23.5	23.6	23.0	24.3
Principal applicants	59.0	38.0	37.2	38.8	38.6	35.8	33.1	38.6	25.2	30.5	28.4	32.7	29.3	26.5	22.6	30.3
Spouse and dependants	31.1	39.5	38.9	40.2	29.2	33.9	32.9	35.0	12.4	22.2	21.1	23.3	21.2	23.3	22.5	24.0
<b>Family</b>	50.2	39.5	38.9	40.2	52.5	43.5	42.6	44.4	60.1	44.3	43.5	45.1	41.6	33.0	32.3	33.6
Parents and grandparents	71.6	45.5	41.3	49.7	90.9	41.1	38.3	44.0	160.3	50.3	49.1	51.5	66.1	39.0	32.2	45.8
Spouse and dependants	41.4	39.7	38.5	40.9	36.5	40.7	39.3	42.2	18.9	34.4	32.7	36.2	31.3	29.4	28.4	30.4
<b>Refugee</b>	45.4	41.9	40.5	43.4	50.4	52.3	50.4	54.1	34.6	47.1	44.9	49.2	36.6	35.4	33.9	36.8
<b>Resettled</b>																
Government assisted	58.7	43.9	36.5	51.2	66.2	57.1	48.6	65.6	52.5	50.0	43.7	56.3	43.4	38.1	30.7	45.5
Privately sponsored	62.8	44.0	39.9	48.2	55.8	57.9	29.2	86.6	52.1	59.0	30.2	87.8	39.0	29.8	26.2	33.3
Dependants of resettled refugees	39.3	40.0	37.8	42.3	47.4	51.0	48.2	53.8	28.6	43.8	40.5	47.1	34.2	34.0	31.9	36.1
<b>Protected persons</b>																
In-Canada refugees	50.7	46.1	43.2	49.0	55.0	55.9	52.2	59.5	39.7	51.2	47.1	55.3	40.5	38.7	35.9	41.4
Dependants of protected persons	30.3	38.6	31.7	45.6	32.3	36.8	30.1	43.4	15.9	39.7	28.0	51.4	28.5	33.4	27.1	39.7
<b>Others</b>	63.4	45.5	41.3	49.7	67.4	50.3	44.9	55.7	80.2	39.0	35.7	42.3	44.1	32.1	28.4	35.8
<b>Immigration landing year</b>																
1980 to 1989	65.1	42.0	41.0	43.0	63.7	43.9	42.8	45.1	72.9	47.9	46.7	49.0	47.5	32.9	31.9	33.8
1990 to 2002	48.7	39.4	38.7	40.0	43.0	41.0	40.2	41.8	38.5	39.2	38.4	40.0	33.9	29.5	28.9	30.1
2003 to 2011	29.7	34.7	33.9	35.6	32.2	36.6	35.7	37.5	16.0	28.8	27.7	29.8	23.3	25.8	25.1	26.5
<b>Source world region</b>																
United States	38.7	39.8	37.0	42.7	51.8	55.1	51.5	58.7	29.9	39.1	35.1	43.2	37.3	37.8	34.7	40.9
Caribbean and Central and South America	60.1	49.1	47.7	50.6	60.2	59.3	57.1	61.4	47.9	52.1	50.1	54.2	47.4	42.4	40.9	43.9
Western Europe	48.0	40.4	38.6	42.1	55.9	53.3	51.0	55.5	43.9	44.9	42.7	47.2	42.6	37.3	35.7	38.9
Eastern Europe	51.6	44.2	42.7	45.8	45.8	45.9	44.1	47.7	44.4	49.0	47.1	50.9	32.9	30.3	29.0	31.7
Sub-Saharan Africa	47.7	45.3	43.0	47.6	46.0	51.8	48.8	54.8	28.4	41.6	38.5	44.7	33.2	33.5	31.5	35.6
Southwest Asia, Middle East and North Africa	36.6	37.5	35.9	39.0	41.0	43.7	41.9	45.5	31.1	45.5	43.0	47.9	29.2	30.3	28.9	31.7
South Asia	35.9	32.7	31.9	33.6	38.6	38.6	37.5	39.6	41.4	45.6	44.3	46.9	33.7	31.8	30.9	32.7
Southeast Asia	52.1	44.6	43.2	46.0	43.7	43.3	41.7	45.0	33.2	38.7	36.9	40.4	34.0	31.0	29.8	32.2
East Asia	39.2	32.6	31.8	33.4	28.4	27.4	26.5	28.2	20.8	21.2	20.4	22.0	17.9	16.2	15.6	16.8

<sup>†</sup> Standardization used the overall NHS population outside Quebec as the reference population; leading causes ranked for the immigrant population.

Notes: ASHR = Age-standardized hospitalization rate. IMDB = Longitudinal Immigration Database. NHS = National Household Survey. DAD = Discharge Abstract Database. OMHRS = Ontario Mental Health Reporting System.

Sources: 2011 NHS-DAD-OMHRS linked data and 1980-to-2016 IMDB-DAD-OMHRS linked database.

economic immigrants. Economic immigrants must demonstrate their capacity to integrate into the Canadian economy as part of the selection process,<sup>2</sup> requirements that would exclude individuals who are not healthy enough to work. By contrast, family-class immigrants are selected based on their relationship with current Canadian citizens or permanent residents, and refugees are selected based on their need for protection.<sup>2</sup> As such, family-class immigrants and refugees may include individuals with health conditions that could impact their ability to work, potentially making economic immigrants systematically less likely to require hospitalization than other classes of immigrants. The finding of higher ASHRs among refugees is consistent with previous analyses of immigration data<sup>11, 27</sup> and may be partially attributable to pre-migration experiences, including poor sanitation and nutrition, reduced health care access, and mental health concerns<sup>28</sup> that could be associated with increased risk of hospitalization after their arrival in Canada.

In addition, there are also differences in health screening practices for economic applicants that may partially explain their lower ASHRs, compared with family- and refugee-class immigrants. Specifically, under the 2002 *Immigration and*

*Refugee Protection Act*, refugee- and family-class immigrants (with the exception of parents and grandparents) are exempt from medical inadmissibility based on excessive demand for Canada’s publicly funded health or social services.<sup>2</sup> By contrast, the excessive demand provision continues to apply to economic applicants. Thus, some family- and refugee-class immigrants could have been deemed inadmissible on health-related grounds had they applied to the economic stream and been diagnosed with a health condition more likely to require hospitalization. This hypothesis is consistent with a previous study, where immigrants to Canada were less likely than immigrants to the United States to report having a serious chronic health condition, as the United States does not consider excessive demand in its health screening process.<sup>29</sup>

When world region of origin is considered, ASHRs were lowest among immigrants from East Asia (males and females) and highest among male immigrants from Sub-Saharan Africa and female immigrants from the Caribbean and Central and South America. These results are consistent with a previous study of cardiovascular disease hospitalization rates in Ontario, where the rates for Chinese immigrants were substantially lower than those for South Asian and European immigrants, as well as for

non-immigrants.<sup>30</sup> A combination of sociodemographic factors,<sup>31,32</sup> lifestyle characteristics<sup>33</sup> and use of traditional medicines,<sup>34</sup> as well as differential health system use (e.g., less contact with general practitioners) and access<sup>35,36</sup> by East Asian immigrants, could contribute to these results. In addition, ongoing epidemiologic transitions with an increasing proportion of morbidity and mortality attributable to chronic diseases in both Sub-Saharan Africa<sup>37</sup> and the Caribbean and Central and South America<sup>38</sup> could also contribute to the elevated hospitalization rates among immigrants from these regions. By contrast, risk factors associated with chronic disease, such as tobacco use and overweight and obesity, contribute to a smaller burden of disease in some East Asian countries.<sup>39</sup> However, differences in the mix of immigrant types from different world regions may also partially explain the observed differences in ASHRs. For example, 68% of immigrants from East Asia in the IMDB–DAD database were economic-class applicants, compared with 36% of applicants from Sub-Saharan Africa and 33% from the Caribbean and Central and South America. As previously described, there are differences in health screening requirements across application classes that may influence the subsequent risk of hospitalization.

A number of methodological issues have been accounted for in this study. To refine the calculation of hospitalization rates, tax file records that are part of the IMDB were used to remove approximately 17% of immigrants who landed in Canada as permanent residents since 1980, who were presumed to have emigrated by 2011. While the measurement of emigration is complex and the use of tax records may underestimate it to some degree, their good population coverage and the fact that they are an annual direct measure with timely availability are advantages of this strategy.<sup>40</sup> To improve completeness, mental health hospitalization discharge data from Ontario were included in this study by linking the discharge-related records from the OMHRS in the SDLE. Interestingly, mental health was ranked as the fifth leading cause of hospitalization in male immigrants and the sixth leading cause among females (excluding pregnancy). Further investigation is warranted to better understand the mental health needs of immigrants and will be the subject of a subsequent analysis. Finally, this study is further strengthened by the removal of hospital transfers in the DAD and the OMHRS. By converting these transfers to single hospitalization events and calculating ASHRs, it was possible to refine the comparison of immigrant hospitalization rates with those of the Canadian-born population.

## Limitations

A number of potential confounding factors may have influenced the observed differences in ASHRs between subgroups of the immigrant cohort. For example, the distribution of applicants in various admission classes differs by country of origin, and this could partially confound differences in ASHRs between immigrants by world region. Differences in the countries of origin among cohorts of immigrants arriving in the 1980s,

compared with the 2000s, could also have influenced the observed differences in ASHRs by immigrant landing year. Further, while all hospitalization rates were age-standardized based on age on Census Day 2011, the current analysis did not account for age at migration. If migration at a younger age influences the risk of subsequent hospitalization and is also related to any of the measured immigration characteristics (e.g., immigration class), the observed differences between subgroups of immigrants could be confounded. Future studies employing a multivariate analytical approach that can account for potential confounders may allow for further refinement and identification of driving factors associated with differences in ASHRs between subgroups of immigrants, while adjusting for additional characteristics, like age at migration.

As previously described,<sup>11</sup> hospital use is somewhat limited as a proxy for health status since it does not capture other aspects of health system use (e.g., primary care) that may relate to conditions not requiring hospitalization. Hospital discharge data typically represent more severe outcomes along the spectrum of disease, and, therefore, it would be useful to interpret the findings of this study within the context of other immigration health indicator data. However, given that these limitations apply to both the immigrant and the Canadian-born cohorts, this study offers a unique comparison of hospitalization between these populations to support the evidence base on health care utilization patterns in Canada as well as migration health trends, such as the HIE.

## Conclusion

This study generates new knowledge on hospitalization events among immigrant and Canadian-born populations using linked administrative immigration and hospital data. The results show that immigrants have lower acute-care hospitalization rates than the Canadian-born population, even after age standardization. These results improve upon previous work<sup>11</sup> by including a Canadian-born reference cohort and support the results of previous studies that have demonstrated the existence of the HIE in Canada, the magnitude of which tends to decrease over time.<sup>3-9</sup> This study demonstrated that the lowest ASHRs are seen among economic immigrants, an observation that applies to both males and females across the four leading causes of hospitalization.

Data from the 2016 Census indicate that one in five Canadians are immigrants;<sup>1</sup> therefore, knowledge on immigrant health is critical to inform health system policy and planning. Future areas of study that could further contribute to understanding patterns of immigrant health include more detailed analyses of specific causes of hospitalization (e.g., mental health), as well as multivariate analyses to account for differences across immigrant subgroups. Increased understanding of both the patterns and the determinants of immigrant health outcomes is essential to informing future health policy making, including immigrant health screening, health promotion and interventions aimed at improving continuity of care over the course of settlement in Canada.

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