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Research

Hospital stays for hepatitis B or C virus infection or primary liver cancer among immigrants: a census-linked population-based cohort study

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Abstract

Background: The recent increase in the incidence of primary liver cancer in Canada has been attributed to a higher proportion of immigrants from countries endemic for hepatitis B virus (HBV) and hepatitis C virus (HCV). We examined hospital discharges for liver disease in Canada, focusing on those for all liver-related diseases, HBV infection, HCV infection and primary liver cancer, by 3 immigration-related variables: immigration status, duration of residence in Canada and risk level of the source country.

Methods: We calculated annualized crude and age-standardized rates of a hospital stay in Canada for HBV infection, HCV infection, primary liver cancer and all liver-related diseases using data from the 2006 Canadian census (long form) linked to the Canadian Institute for Health Information Discharge Abstract Database for fiscal years 2006/07 to 2008/09. We estimated the odds of a hospital stay using logistic regression for the 3 immigration-related variables, adjusting for sociodemographic indicators.

Results: Immigrants were less likely than Canadian-born residents to be discharged with a diagnosis of any liver-related condition (odds ratio [OR] 0.83, 95% confidence interval [CI] 0.78–0.89); however, they were more likely to be discharged with a diagnosis of HBV infection (OR 2.02, 95% CI 1.57–2.60) and primary liver cancer (OR 1.43, 95% CI 1.22–1.68). There was a clear association between a hospital stay for HBV infection and immigration from HBV-endemic countries (OR 5.15, 95% CI 3.87–6.84) and between a stay for HCV infection and immigration from HCV-endemic countries (OR 2.98, 95% CI 1.74–5.11). Adjustment for low income status and urban residence did not change the results.

Interpretation: Although the odds of a liver-related hospital stay were lower among immigrants than among those born in Canada, immigrants from countries at high risk for HBV infection, HCV infection and primary liver cancer were more likely than Canadian-born residents to have a corresponding liver-related hospital stay. These findings emphasize the importance of identifying immigrants with hepatitis and engaging them in care to prevent complications.

Although primary liver cancer (the majority of which is hepatocellular carcinoma) is uncommon in Canada, representing about 1% of all cancers, its incidence has increased threefold since the early 1980s.[1,2] Much of this increase has been attributed to a higher proportion of immigrants from countries endemic for the hepatitis B virus (HBV) and, to a lesser extent, the hepatitis C virus (HCV).[3–7] Globally, chronic infection with HBV or HCV, or both, is the underlying cause in about 80% of cases of hepatocellular carcinoma and, therefore, also primary liver cancer.[8]

Although HBV and HCV are both blood-borne, the infections have distinct epidemiologic features and risk factors. The seroprevalance of HBV in Canada was estimated to be as low as less than 0.5% in a population-based household survey sample,[9] whereas about 3% of new immigrants are chronically infected with the virus.[10] In patients with chronic HBV infection, the lifetime risk of dying from liver cirrhosis or liver cancer is about 15% to 25%.[11,12] Canada also has a low prevalence of chronic HCV infection (about 0.7%).[13] For both HBV and HCV, there may be underascertainment of prevalence.[14,15] Risk factors for HBV infection include sexual contact, intravenous drug use and vertical transmission (e.g., from mother to baby),[16] whereas most newly identified HCV infections occur among injection drug users and infected immigrants from HCV-endemic countries.[17]

Patients with chronic HBC or HCV infection are typically asymptomatic, and the condition is often diagnosed decades after seroconversion, when they may present with end-stage

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liver disease or primary liver cancer or both.[18] Population-based data have shown that complications of chronic HCV infection are increasing owing to aging of the infected population and progression of liver fibrosis,[13,19] but the impact of immigration on these trends has not been elucidated. It is important to assess liver disease risk among immigrants because this may pose a substantial burden for the health care system owing to the potential need for costly antiviral medications, liver transplantation and specialized treatment for primary liver cancer

To understand the role of immigration in the burden of liver disease in Canada, we used uniquely linked census and hospital cohort data to examine hospital stays for HBV infection, HCV infection and primary liver cancer by 3 immigration-related variables: immigration status, duration of residence in Canada and disease-specific risk level of the source country. Our objectives were to examine differences in rates of a liver-related hospital stay for HBV infection, HCV infection and primary liver cancer (and overall) according to whether the person was an immigrant to Canada, and, if so, by duration of residence; to examine whether there were differences in the rates for immigrants from countries at high risk for the 3 disorders; and to examine whether the observed differences persisted after socioeconomic status was controlled for.

Methods

Data sources

The data for the 2006 Canadian census (long form) cohort were individually linked to the Canadian Institute for Health Information Discharge Abstract Database. The long-form census represents about 20% of private households in Canada and provides information about immigrants, including birthplace, immigration year and socioeconomic information. The Discharge Abstract Database includes all inpatient hospital stays, with about 3 million discharges per year from all of Canada excluding Quebec. About 4.6 million census respondents (excluding those from Quebec) were eligible for linkage to the Discharge Abstract Database for fiscal years 2006/07 to 2008/09. We conducted a hierarchical deterministic linkage using date of birth, sex and residential postal code. We used postal code information from the Historical Tax Summary File to account for changes in residence. The Historical Tax Summary File is a compilation of annual tax return files representing unique individuals for whom a tax declaration was produced in a given year. It contains only personal identifier information such as name, date of birth, sex and postal code. This file is used within Statistics Canada to assist in record linkage, specifically through the provision of additional linkage information (i.e., name, postal code) and manual resolution of doubtful links. The weighted coverage rates in the linked census–Discharge Abstract Database data were at a reasonably high level (78%–80%), and a validation study showed that the linked file was suitable for health-related research and was broadly representative of immigrants and most residents in private households in Canada (outside of Quebec). Additional information regarding the linkage process, validation and linkage cohort are reported elsewhere.[20] The linkage was approved by Statistics Canada's Policy Committee[21] and is governed by the Directive on Record Linkage.[22]

Study cohort

The study cohort included only adult (aged 20 years or more) residents in private households of Canada (excluding Quebec and the territories) from the 2006 long-form census–Discharge Abstract Database linkage cohort.

Variables of interest

A landed immigrant is a person who is not a Canadian citizen by birth but who has been granted the right to live in Canada permanently by Canadian immigration authorities.[23] To examine the effect of duration of residence, we categorized immigrants by their immigration year. Long-term immigrants were those who immigrated to Canada before 1996, whereas recent immigrants arrived between 1996 and 2006 (i.e., ≤ 10 years before the census). We chose 10 years as the cutoff to examine whether elevated risk of a hospital stay would be detected among the more recent immigrant group. To study the effect of source-country-specific disease risk, we classified immigrant birthplace by the estimated prevalence of HBV infection and HCV infection based on clinical practice guidelines for immigrants and refugees in Canada,[10,24] which identified the prevalence of these infections at the country level using data from the US Centers for Disease Control and the World Health Organization (Appendix 1, available at www.cmajopen.ca/content/4/2/E162/suppl/DC1). For HBV infection, source countries were classified by their estimated prevalence as low (< 2%), intermediate (2% to < 8%) or high (≥ 8%).[25,26] For HCV infection, the corresponding values were < 3%, ≥ 3% to 5% and > 5%.[24,27] The latter categories differed slightly from the World Health Organization definition of intermediate (3%–10%) and high (> 10%) prevalence because there were limited numbers of immigrants from countries with a prevalence of HCV infection greater than 10% (Bolivia, Burundi, Cameroon, Egypt, Guinea, Mongolia and Rwanda). Owing to a paucity of country-level data on risk of primary liver cancer and the fact that viral hepatitis accounts for most cases of the disease globally, we defined countries as high risk for primary liver cancer if the prevalence of HBV or HCV infection was in the high-risk category.

Additional covariates obtained from the census included age, sex, urban residence (defined as residence within a census metropolitan area or census agglomeration) and low income status. We categorized age as 20–49, 50–69 and ≥ 70 years; smaller subgroupings were not possible owing to small numbers. In the census, a person was identified as being of low income status if the total income of his or her economic family (or of the person, if not in an economic family) was below the low-income threshold, which varied by economic family size and size of the area of residence.[28] For example, for an economic family of 4 people in an urban area, the before-tax threshold was $38 610, whereas for an economic family of 4 people in a rural area, the threshold was $26 579.

The primary outcome was an inpatient liver-related hospital discharge or stay between Apr. 1, 2006, and Mar. 31, 2009

(in accordance with the accounting practices of the Discharge Abstract Database). Hospital discharge was defined as liver-related if the most responsible diagnosis field included a diagnosis code from the International Classification of Diseases, 10th Revision/Canadian Classification of Interventions procedure codes for a liver condition or related complications, or the patient underwent liver transplantation (Appendix 2, available at www.cmajopen.ca/content/4/2/E162/suppl/DC1). In a sensitivity analysis in which liver-related outcome was defined by whether any secondary diagnosis (diagnoses 2 to 25) was a complication of liver disease (rather than requiring the primary diagnosis to be liver-related), the former definition was found to be too inclusive; we also included procedure codes for liver transplantation. Thus, to further classify the type of liver-related hospital stay, we examined the following codes hierarchically from all 25 diagnosis fields in the Discharge Abstract Database: B16.x, B17.0, B18.0, B18.1 and Z22.5 for HBV codes, and B17.1 and B18.2 for HCV codes. We further reclassified all liver-related hospital stays according to the presence of a diagnosis code for primary liver cancer (C22) in any of the diagnosis fields.

Statistical analyses

We calculated annualized crude and age-standardized hospital discharge rates for all liver-related diseases and for disease-specific subgroups (HBV infection, HCV infection and primary liver cancer) by immigrant status, duration of residence and disease-specific risk of the source country, with Canadian-born as the reference group. We generated descriptive statistics to provide a comparison of the study population by immigration-related characteristics. The overall cohort was used as the reference population in age standardization. We used multivariate logistic regression analyses to assess the relation between immigration-related variables and ever being admitted to hospital, with adjustment for age, sex, low income and place of residence. Low income was a proxy for high-risk behaviour, and place of residence reflected proximity to hospitals. We conducted separate regressions for all liver-related hospital stays and specific diseases (HBV infection, HCV infection and primary liver cancer). Analyses were conducted with the use of SAS version 9.2.

Results

The final study cohort included 3 376 595 respondents with 907 484 hospital stays. The mean age of the immigrants was 51 years, compared with 46 years for the Canadian-born population (Table 1). Most (75%) of the immigrants in our cohort relocated to Canada before 1996. Recent immigrants were younger than their established counterparts (39 v. 54 years). A greater proportion of immigrants than Canadian-born respondents were classified as having low income (18% v. 10%) and living in an urban location (94% v. 74%). The proportions of immigrants from countries deemed high risk for HBV infection, HCV infection and primary liver cancer were 29%, 6% and 32%, respectively. The corresponding values for recent immigrants were 42%, 8% and 47%.

About 1% (7833) of all inpatient hospital stays among the cohort during the 3-year study period were liver-related. Among these stays, a diagnosis of HBV infection, HCV infection and primary liver cancer was present in 4%, 8% and 11% of cases, respectively. The age-standardized hospital discharge rate per 100 000 population for immigrants was significantly lower than that for the Canadian-born population for all liver-related stays (59.8 [95% confidence interval (CI) 57.1–62.7] v. 77.8 [95% CI 75.8–79.9]) and for stays related to HCV infection (5.0 [95% CI 4.2–5.9] v. 6.3 [95% CI 5.8–7.3]) (Table 2). Conversely, the age-standardized discharge rates for HBV infection and primary liver cancer were significantly higher for immigrants than for people born in Canada (4.7 [95% CI 3.9–5.6] v. 2.7 [95% CI 2.3–3.1] and 10.6 [95% CI 9.5–11.8] v. 7.7 [95% CI 7.1–8.4] respectively) (Table 2). Lower crude discharge rates were observed for recent immigrants than for those born in Canada across all disease categories, but this effect of residence duration disappeared after age-standardization, especially for HBV infection and primary liver cancer.

The disease-specific risk of the source country had a strong association with liver-related stays (Table 2). For HBV infection, immigrants from low-risk countries had a significantly lower age-standardized discharge rate than Canadian-born respondents (1.7 [95% CI 1.0–2.7] v. 2.7 [95% CI 2.3–3.1]), whereas immigrants from high-risk countries had a significantly higher rate (12.5 [95% CI 10.2–15.5]). Similar results were observed for hospital stays related to HCV infection and, to a lesser extent, to primary liver cancer (Table 2).

Multivariate analyses showed similar findings (Table 3). Compared with people born in Canada, immigrants had lower age- and sex-adjusted odds of any liver-related hospital stay (odds ratio [OR] 0.83, 95% CI 0.78–0.89) but higher odds of a stay for HBV infection (OR 2.02, 95% CI 1.57–2.60) and primary liver cancer (OR 1.43, 95% CI 1.22–1.68). An increased likelihood of a hospital stay related to HBV infection compared with the Canadian-born population was particularly evident among immigrants from high-risk source countries (OR 5.15, 95% CI 3.87–6.84). Although no significant immigration effect was observed for stays related to HCV infection (OR 0.92, 95% CI 0.73–1.16), immigrants from high-risk countries had almost triple the odds of a hospital stay compared with people born in Canada (OR 2.98, 95% CI 1.74–5.11). The increasing risk of a stay by duration of residence was evident after adjustment for age and sex, particularly for HBV infection, primary liver cancer and all liver diseases combined. For example, the HBV-infection-specific OR for long-term immigrants was 2.17 (95% CI 1.66–2.83), whereas that for recent immigrants was 1.45 (95% CI 0.85–2.47). Further adjustment for low income and area of residence did not substantially alter these findings.

Interpretation

Using high-quality census-based linked data that individually characterized immigration status, we found that, compared with people born in Canada, immigrants were more likely to be discharged with a diagnosis of HBV infection or primary

Table 1: Selected characteristics of the adult (aged 20 years or more) 2006 census cohort, by immigration status and duration of residence in Canada (excluding Quebec and the territories)

Characteristic	Canadian-born, no. (%)* (*n* = 2 486 970)	Immigrants, no. (%)*		
		Overall (*n* = 889 625)	Duration of residence, yr	
			> 10 (*n* = 664 485)	≤ 10 (*n* = 225 140)
Age, yr, mean	46	51	54	39
Men	1 209 570 (48.6)	420 970 (47.3)	316 415 (47.6)	104 555 (46.4)
Low income	257 650 (10.4)	161 430 (18.1)	93 220 (14.0)	68 210 (30.3)
Urban residence	1 826 720 (73.4)	839 400 (94.4)	620 445 (93.4)	218 960 (97.2)
Source country risk level†				
HBV infection				
Low	–	332 715 (37.4)	307 315 (46.2)	25 400 (11.3)
Medium	–	296 320 (33.3)	190 225 (28.6)	106 095 (47.1)
High	–	260 590 (29.3)	166 945 (25.1)	93 645 (41.6)
HCV infection				
Low	–	693 895 (78.0)	546 885 (82.3)	147 010 (65.3)
Medium	–	145 320 (16.3)	84 975 (12.8)	60 345 (26.8)
High	–	50 410 (5.7)	32 625 (4.9)	17 785 (7.9)
Primary liver cancer				
Low	–	608 080 (68.4)	489 495 (73.7)	118 585 (52.7)
High	–	281 545 (31.6)	174 990 (26.3)	106 555 (47.3)

Note: HBV = hepatitis B virus, HCV = hepatitis C virus.
*Unless indicated otherwise.
†According to estimated prevalence of HBV infection and HCV infection in the source country based on clinical practice guidelines for immigrants and refugees in Canada.[10,24] HBV infection: low risk < 2%, medium risk 2% to < 8%, high risk ≥ 8%; HCV infection: low risk < 3%, medium risk 3% to 5%, high risk > 5%; primary liver cancer: high risk = high risk for HBV or HCV infection.

Table 2: Annualized crude and age-standardized hospital discharge rates per 100 000 population, by immigrant and risk-related variables, for all liver disease, HBV infection, HCV infection and primary liver cancer

Group; variable	Disease; rate per 100 000 population							
	All liver disease		HBV infection		HCV infection		Primary liver cancer	
	Crude	Age-standardized (95% CI)	Crude	Age-standardized (95% CI)	Crude	Age-standardized (95% CI)	Crude	Age-standardized (95% CI)
Canadian-born	75.4	77.8 (75.8–79.9)	2.6	2.7 (2.3–3.1)	6.2	6.3 (5.8–7.3)	7.3	7.7 (7.1–8.4)
Immigrant	66.4	59.8* (57.1–62.7)	5.1	4.7* (3.9–5.6)	5.5	5.0* (4.2–5.9)	12.4	10.6* (9.5–11.8)
Duration of residence, yr								
> 10	79.8	65.0* (61.7–68.5)	5.8	5.1* (4.2–6.2)	6.5	5.3* (4.4–6.3)	14.9	10.9* (9.6–12.3)
≤ 10	26.9	45.2* (38.1–53.7)	2.8	5.4 (3.2–9.2)	2.8	4.5 (2.7–7.5)	5.9	15.7* (11.3–22.9)
Source country risk level								
Low	–	–	2.0	1.7* (1.0–2.7)	5.4	4.6* (3.8–5.5)	10.7	7.8 (6.7–9.0)
Medium	–	–	2.9	3.0 (2.0–4.4)	2.1	2.1* (1.1–4.1)	–	–
High	–	–	11.4	12.5* (10.2–15.5)	17.9	23.0* (15.3–34.5)	16.8	20.0* (16.9–23.6)

Note: CI = confidence interval, HBV = hepatitis B virus, HCV = hepatitis C virus.
*Significantly different from the value for the Canadian-born cohort.

Table 3: Age- and sex-adjusted and fully adjusted* odds ratios for hospital discharge for all liver disease, HBV infection, HCV infection and primary liver cancer on multivariate logistic regression analyses†

	Disease; OR (95% CI)							
	All liver-related disease		HBV infection		HCV infection		Primary liver cancer	
Group; variable	Age- and sex-adjusted	Fully adjusted	Age- and sex-adjusted	Fully adjusted	Age- and sex-adjusted	Fully adjusted	Age- and sex-adjusted	Fully adjusted
Canadian-born	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Immigrant	0.83‡ (0.78–0.89)	0.92‡ (0.85–0.98)	2.02‡ (1.57–2.60)	2.07‡ (1.58–2.71)	0.92 (0.73–1.16)	0.85 (0.66–1.08)	1.43‡ (1.22–1.68)	1.40‡ (1.18–1.64)
Canadian-born	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Immigrant duration of residence, yr								
> 10	0.89‡ (0.83–0.95)	0.99 (0.92–1.06)	2.17‡ (1.66–2.83)	2.29‡ (1.73–3.03)	0.98 (0.76–1.25)	0.93 (0.72–1.21)	1.44‡ (1.22–1.70)	1.40‡ (1.18–1.66)
≤ 10	0.54‡ (0.45–0.64)	0.56‡ (0.47–0.67)	1.45 (0.85–2.47)	1.30 (0.75–2.26)	0.66 (0.37–1.18)	0.51 (0.28–0.91)	1.32 (0.88–1.98)	1.26 (0.83–1.90)
Canadian-born			1.00	1.00	1.00	1.00	1.00	1.00
Risk level of immigrant source country								
Low			0.72 (0.44–1.20)	0.79 (0.48–1.33)	0.88 (0.68–1.14)	0.83 (0.63–1.08)	1.10 (0.89–1.30)	1.10 (0.87–1.29)
Medium			1.13 (0.70–1.82)	1.20 (0.73–1.96)	0.47 (0.22–0.99)	0.41 (0.19–0.87)		
High			5.15‡ (3.87–6.84)	5.28‡ (3.87–7.20)	2.98‡ (1.74–5.11)	2.49‡ (1.44–4.29)	2.60‡ (2.12–3.27)	2.60‡ (2.05–3.22)

Note: CI = confidence interval, OR = odds ratio.
*Adjusted for rural v. urban residence and for low income status in addition to age and sex.
†All analyses used Canadian-born as the reference group. ORs are estimates.
‡Significantly different from the value for the Canadian-born cohort.

liver cancer but were less likely to be discharged with a diagnosis of HCV infection or any liver-related condition. These findings emphasize the importance of immigrants' life experience for their burden of health and use of health care services. The lower odds of an overall liver-related hospital stay observed among immigrants, particularly recent arrivals, are consistent with the "healthy immigrant effect" hypothesis. According to this dominant theme in immigration health research in Canada, immigrants appear to be healthier than the Canadian-born population by virtue of being capable of successfully moving themselves and, in many cases, their families from one country to another.[29,30] However, our results show that the health status of immigrants is clearly heterogeneous, with higher odds for a hospital stay for HBV infection and primary liver cancer compared with people born in Canada, particularly among immigrants from high-risk countries.

Our finding that immigrants had lower odds for a hospital stay for HCV infection compared with those born in Canada should be taken within the context of the higher prevalence of HCV infection in the Canadian-born "baby boom" cohort compared with people born earlier or later than this group.[31,32] This age profile of HCV prevalence was not seen in immigrants. This has implications for potential HCV screening strategies.[33]

The results of multivariate logistic regression analyses suggest that, in general, there was a duration effect, as the healthy immigrant effect diminished over time. This likely reflects the fact that recent immigrants were considerably younger than those who had been in Canada longer (mean age 39 v. 54 years) and that most liver diseases, including HBV and HCV infection, typically require decades to progress to advanced stages.

Our results also show that the source country risk level is an important factor influencing the likelihood of a hospital stay for HBV infection, HCV infection and primary liver cancer among immigrants. The finding that 42% and 8%, respectively, of recent immigrants immigrated from countries with high risk for HBV and HCV infection has implications for future demand for health care services to manage complications of liver disease. Canada has seen a shift in immigration from low-risk countries (such as those in western Europe) to countries where there is a high risk of HBV and HCV infection (such as those in Asia, Africa and Central and South America). The higher odds of a stay for primary liver cancer among immigrants compared with people born in Canada suggests that the rising incidence of this disease in Canada is likely at least partly attributable to immigration from areas endemic for HBV and HCV.[3,4] To mitigate this future disease burden, such initiatives as serologic testing, prevention measures (e.g., vaccination for HBV), public health education, disease counselling and linkage to care among at-risk immigrants have been proposed.[1] In a proof-of-concept study from the Netherlands, a successful outreach campaign among Chinese immigrants showed high acceptance of HBV screening and a high prevalence of chronic HBV infection (8.5%).[34] Over a

third of those with chronic infection were referred for specialist care, 43% of whom started antiviral treatment within 1 year of follow-up.

Our results confirm previous findings based on less rigorous approaches and in more specific settings. In a study based on ecological analysis of the Discharge Abstract Database, Carrière and colleagues[35] found higher rates of a hospital stay for primary liver cancer in neighbourhoods with a high concentration of immigrants. Similarly, a linkage study that included the top 3 immigrant-receiving provinces in Canada (Ontario, Quebec and British Columbia) showed an elevated incidence of primary liver cancer among immigrants compared with people born in Canada.[5,6]

Limitations

This study is limited by the lack of important risk factors for liver disease progression, including drug use, sexual contact, alcohol consumption, obesity and diabetes, as well as physician claim data in the multivariate analysis. Limited data on diabetes were available from the Discharge Abstract Database for those with a hospital stay, as some inpatients may have diabetes as a comorbid condition. Among those without a hospital stay, there is no information regarding whether they have diabetes. The possibility of a hospital stay due to a comorbid condition such as diabetes or HIV infection could be explored in the future. Regarding the lack of physician claim data, if immigrants were admitted for HBV or HCV infection more or less often than those born in Canada (owing to such factors as disease severity related to the particular genotype of disease and differences in access to primary and specialist care), this may have under- or overestimated the results. Second, HBV infection and HCV infection cluster in certain subpopulations such as inmates and long-term care residents, on-reserve Aboriginal people and homeless people, groups not covered or not well covered in the long-form census. However, rigorous quality assessment and critical review concluded that the census produces reliable data for immigrants.[36] Third, we did not examine the potential interaction between source country risk level and duration of residence in Canada because of sample size limitations. Fourth, estimates for the viral hepatitis risk levels of the source countries cannot be considered definitive. In some cases, the World Health Organization and US Centers for Disease Control have reported HBV and HCV prevalence figures at regional rather than national levels (e.g., the Amazon areas of Colombia and Brazil rather than the entire countries). Because census data do not differentiate specific regions for a particular birthplace, we extrapolated regional prevalence figures to nationwide estimates in some cases. Also, most global HBV and HCV studies report seroprevalence rates based on cross-sectional and at times questionable studies in selected populations not representative of the general population, especially in Africa and Asia. Therefore, a wide range of prevalence estimates exist, which necessitated selection of the "best estimates" based on World Health Organization and Centers for Disease Control data. We assumed that HBV and HCV prevalence among immigrants would be similar to that reported in their source countries. In light of the healthy immigrant effect, this is likely an imperfect assumption but is, however, a reasonable proxy for the relative level of risk among immigrants. Last, there may have been loss to follow-up of the cohort, as some census respondents may have left Canada right after the survey. If immigrants are more (or less) prone to leave the country than their Canadian-born counterparts, this may have led to overestimation (or underestimation) of rates among immigrants. However, this circumstance would not have affected our overall conclusions.

Conclusion

This study shows the importance of immigration in hospital discharge for viral hepatitis (particularly due to HBV) and primary liver cancer among residents in private households and the potential impact on future disease burden in Canada outside of Quebec, given the immigration trend. Infectious diseases such as HBV and HCV infection can have long-term health consequences that make people more vulnerable to other diseases, including cancer.[37] The evolving understanding of the links between infectious and chronic diseases will inform prevention and treatment efforts, including screening and active engagement in care. This study also shows the importance of conducting analysis at a more specific level with large population-based linked data sets.

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