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Increased influenza-related healthcare utilization by residents of an urban aboriginal community

K. M. CHARLAND[1,2,3,4]*, J. S. BROWNSTEIN[1,2,4], A. VERMA[3,4], T. BREWER[5], S. JONES[6,7], A. GATEWOOD HOEN[1,2] AND D. L. BUCKERIDGE[3,4,8]

[1] *Children's Hospital Informatics Program at the Harvard–MIT Division of Health Sciences and Technology (CHIP), Boston, MA, USA*
[2] *Department of Pediatrics, Harvard Medical School, Boston, MA, USA*
[3] *McGill Clinical and Health Informatics (MCHI), McGill University, Montreal, Canada*
[4] *Department of Epidemiology, Biostatistics and Occupational Health, McGill University, Montreal, Canada*
[5] *Department of Medicine, McGill University, Montreal, Canada*
[6] *Department of Family Medicine, McGill University, Montreal, Canada*
[7] *Kateri Memorial Hospital Centre, Kahnawá:ke, Canada*
[8] *Office of Surveillance and Epidemiology, Montreal Public Health Department, Montreal, Canada*

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SUMMARY

Most studies describing high rates of acute respiratory illness in aboriginals have focused on rural or remote communities. Hypothesized causes include socioeconomic deprivation, limited access to healthcare, and a high prevalence of chronic disease. To assess influenza rates in an aboriginal community while accounting for healthcare access, deprivation and chronic disease prevalence, we compared rates of influenza-related outpatient and emergency-department visits in an urban Mohawk reserve (Kahnawá:ke) to rates in neighbouring regions with comparable living conditions and then restricted the analysis to a sub-population with a low chronic disease prevalence, i.e. those aged <20 years. Using medical billing claims from 1996 to 2006 we estimated age-sex standardized rate ratios. The rate in Kahnawá:ke was 58% greater than neighbouring regions and 98% greater in the analysis of those aged <20 years. Despite relatively favourable socioeconomic conditions and healthcare access, rates of influenza-related visits in Kahnawá:ke were elevated, particularly in the younger age groups.

Key words: Influenza (seasonal).

INTRODUCTION

During the first wave of the influenza A(H1N1) pandemic, First Nations (Indian) reserves in northern Manitoba, Canada experienced high rates of severe influenza infection [1]. Prior to the pandemic, studies of aboriginal populations had demonstrated elevated rates of acute respiratory illness [2–11]. The higher incidence of infection and more severe disease were attributed to several factors including deprived living conditions, limited access to primary care, exposure to tobacco smoke and a high prevalence of chronic disease, particularly type II diabetes [12–14]. However, these hypothesized risk factors vary considerably between First Nations reserves [12] and the majority of published research on aboriginal health

* Author for correspondence: Dr K. M. Charland, 1140 Pine Avenue West, Montreal, Québec, Canada, H3A 1A3.
(Email: katia.charland@mcgill.ca)

Table 1. *Subsets of ICD-9 codes used to define an influenza case*

ICD-9 code	Diagnosis	Influenza	Influenza and Pneumonia	Influenza and bronchitis	Respiratory infection
382·9	Otitis media				●
460	Acute nasopharyngitis				●
461·9	Acute sinusitis				●
465·9	Acute upper respiratory infection				●
466·0	Acute bronchitis			●	●
486	Pneumonia		●		●
487	Influenza	●	●	●	●
490	Bronchitis			●	●
780·6	Fever				●
786·2	Cough				●

has focused on communities located in rural or remote regions [15] where factors related to community isolation (e.g. limited access to goods/services and healthcare [16, 17]) may contribute to the observed high rates of severe disease.

Kahnawá:ke is a First Nations Mohawk reserve with a population of about 7100 (in 2000), located 10 km south of Montreal (Québec, Canada) on the shores of the St Lawrence river [18]. Socioeconomic conditions in Kahnawá:ke are comparable to those in neighbouring regions. In 1995, Kahnawá:ke's average annual *per capita* income was about $30000 [19], slightly higher than the 1996 estimate of $26000 in the adjacent non-reserve neighbourhoods [20]. Further, most males aged >17 years owned cars, suggesting relatively favourable socioeconomic conditions in Kahnawá:ke [21, 22].

Compared to Canadians, there is a higher prevalence of certain chronic diseases in the people of Kahnawá:ke, most notably type II diabetes [23] (7·7/100 in Kahnawá:ke in 2001–2003 *vs.* 4·5/100 in Canadians in 2001) [24]. However, the prevalence is considerably lower than that of other First Nations peoples [24]. Healthcare services are provided free of charge throughout the province to all residents of Quebec and Kahnawá:ke. In fact, healthcare for aboriginals (and non-aboriginals), is accessible on the reserve at the Kateri Memorial Hospital Centre [19]. This is important as uncontrolled chronic disease may increase risk of infection and severe outcomes [14].

To assess influenza rates in this aboriginal community while accounting for underlying factors such as deprivation and chronic disease, we used medical billing claims from 1996 to 2006 and compared the rates of influenza-related visits in Kahnawá:ke to the rates of visits in the neighbouring regions. Furthermore, we conducted a focused analysis on those aged <20 years as there is a low prevalence of chronic disease in this age group.

DATA AND METHODS

Visits to outpatient clinics and emergency departments (OC/ED)

We obtained records of all OC/ED visits for influenza-like illness from 1996 to 2006 for residents of the Greater Montreal Region from the Regie de l'assurance maladie du Québec (RAMQ). RAMQ is the government agency providing health insurance to 99% of the residents of the province of Québec. Each record contained data describing patient age, sex, census tract of residence, date of visit, and an International Classification of Diseases, 9th Revision (ICD-9) diagnostic code. A case was defined as a visit to the OC/ED with an ICD-9 code that is associated with influenza. Although the ICD-9 codes 487 are highly specific for influenza, they lack sensitivity as influenza infection is often implicated in other diagnoses such as pneumonia (ICD-9 code 486). Thus we considered several 'influenza' case definitions based on subsets of ICD-9 codes representing: influenza, influenza and pneumonia, influenza and bronchitis and all respiratory infections (Table 1). In order to assess the sensitivity of the results to the choice of ICD-9 code sets, we conducted separate analyses for each case definition.

To more closely focus our outcome measure on disease rates rather than healthcare utilization, the number of visits per person was limited to one per influenza season (40th CDC week of one calendar year to the 39th CDC week of the following year).

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Fig. 1. Map of Greater Montreal Region showing Kahnawá:ke and adjacent neighbourhoods.

From these records we compiled age-sex strata-specific cumulative counts of cases from 1996 to 2006 for Kahnawá:ke and for Kahnawá:ke's neighbours (Fig. 1). Ethics approval was granted by the McGill University Research Ethics Office (IRB) and by the Onkwata'karitahtshera Health & Social Services Research Council.

Census data

For the regions adjacent to Kahnawá:ke, using census tract population sizes reported in the 1996, 2001 and 2006 Canadian censuses, we calculated at-risk person-time for each age-sex stratum, approximating population sizes for inter-censal years by linear interpolation. For Kahnawá:ke, we used data collected from a separate federal government department, Indian and Northern Affairs Canada (INAC) (www.ainc-inac.gc.ca), because Kahnawá:ke does not participate in the Canadian census. INAC provided population sizes for Mohawks living on the Kahnawá:ke reserve, by age and sex for each individual year (1996–2005).

Statistical analyses

We standardized rates of OC/ED visits to the 2001 Montreal population distribution. For each influenza year and overall, we calculated age- and sex-standardized rate ratios (RR) and corresponding confidence intervals (CI) representing the risk associated with living on the Kahnawá:ke reserve relative to the risk associated with living in adjacent neighbourhoods. Age groups were 0–4, 5–9, 10–14, 15–19, 20–39, 40–64 and $\geqslant$65 years. In a separate analysis of those aged $<$20 years we estimated standardized rate ratios in a similar manner.

RESULTS

The age distributions of the two regions were similar. In Kahnawá:ke, 27% of the population were aged $<$20 years, compared to 28% in the neighbouring region. Using the most specific definition of influenza, from 1996 to 2006, the OC/ED visit rate was 33% higher for residents of Kahnawá:ke compared to residents of adjacent neighbourhoods (RR 1·33, 95% CI 1·26–1·41) (Table 2). The increased risk was more pronounced in the $<$20-year-old populations with influenza-related visit rates in Kahnawá:ke 98% greater than rates in adjacent communities (RR 2·15, 95% CI 1·94–2·37). The elevation in rates in Kahnawá:ke persisted regardless of the choice of ICD-9 code set, although the rate differential was not as marked for the most inclusive set of respiratory infection diagnoses (RR 1·08, 95% CI 1·06–1·09) (Tables 1 and 2). Higher rates in Kahnawá:ke residents were observed for all years from 1996 to 2006 (Fig. 2).

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Table 2. *Standardized rate ratios and confidence intervals for 1996–2006 representing Kahnawá:ke rates relative to rates of adjacent neighbourhoods, for the general population and for the population aged <20 years*

Influenza season	Influenza	Influenza and pneumonia	Influenza and bronchitis	Respiratory infection
All ages	1·58 (1·49–1·67)	1·51 (1·44–1·58)	1·48 (1·44–1·53)	1·21 (1·19–1·23)
<20 yr	1·98 (1·79–2·18)	1·79 (1·65–1·93)	1·61 (1·57–1·70)	1·33 (1·31–1·36)

DISCUSSION

Residents of a prosperous, urban, aboriginal reserve with accessible healthcare were 58% more likely to have an influenza-related OC/ED visit than adjacent but predominantly non-aboriginal communities with comparable living conditions. Furthermore, the elevation in rates was even more pronounced in the analysis of an age group with a relatively low prevalence of chronic disease, i.e. those aged <20 years. Although we could not account for community differences in vaccination uptake, the rates remained elevated during the two influenza years in which there was a poor antigenic match between the vaccine and the circulating strain.

Previous studies of aboriginal populations have demonstrated high rates of respiratory diseases such as respiratory syncytial virus, invasive pneumococcal disease and tuberculosis [2, 12, 25, 26]. Hildes *et al.* [27] studied the incidence of several respiratory infectious diseases in an 'Arctic Indian' community in the Yukon Territory from 1958 to 1961 and documented a high attack rate of influenza A. Using data from Ontario, Canada, Crighton *et al.* found a marked relationship between county-level hospitalization rates for pneumonia and influenza and county percentages of aboriginals [2]. However, in Canada, about half of aboriginals live in remote or rural areas with some reserves accessible only by air [28]. Socioeconomic deprivation is common due to limited access to goods and services and many of these communities have inadequate access to primary care [14, 16, 17]. Therefore factors other than a greater susceptibility to influenza infection may explain their findings.

In Kahnawá:ke the rate of type II diabetes is about 70% higher than that of the Canadian population [24] and type II diabetes is a risk factor for severe influenza infection [29]. Although, in recent years, there has been an increasing prevalence of type II diabetes in the paediatric population, according to the Québec Region First Nations Regional Health Survey there were no observed cases among the 7·4% of First Nations children that had been tested [30]. Even though overt type II diabetes may not explain the high influenza rates in Kahnawá:ke's youth, 40% of Québec's First Nations children are obese (*vs.* 23% of children in Québec) and obesity has recently been implicated in severe respiratory infection [31–33]. On the other hand, Peck *et al.* found that, compared to non-aboriginal children, aboriginal children and in particular infants have higher rates of lower respiratory tract infections [8]; a finding not easily explained by underlying chronic disease.

It is likely that the high rates of smoking in Kahnawá:ke have contributed to the increased influenza rates for all age groups. Due to its inflammatory and immunosuppressive effects, smoking increases susceptibility to infection [34, 35]. Although smoking rates differ between aboriginal communities, more than 50% of Québec's First Nations adults and adolescents smoke [36], compared to fewer than 25% in the non-reserve region surrounding Kahnawá:ke (i.e. Monteregie) [37].

We measured OC/ED visits to estimate influenza infection rates, an approach used by others to compare burdens of illness between aboriginal and non-aboriginal populations for diseases such as bronchiolitis and otitis media [38, 39]. Nevertheless, we cannot exclude the possibility that residents of Kahnawá:ke will have a greater tendency to seek care than their neighbours given the same degree of disease severity. However, studies of First Nations communities elsewhere in Canada have demonstrated that although aboriginals experienced substantially higher rates of hospitalizations and premature mortality due to certain diseases, rates of visits to outpatient healthcare settings were not as great suggesting that residents of these communities do not tend to visit outpatient clinics as readily as non-aboriginals given the same burden of disease [40, 41]. In addition, Shah *et al.* [17] found higher rates of hospital admissions in aboriginals for conditions that may have been prevented

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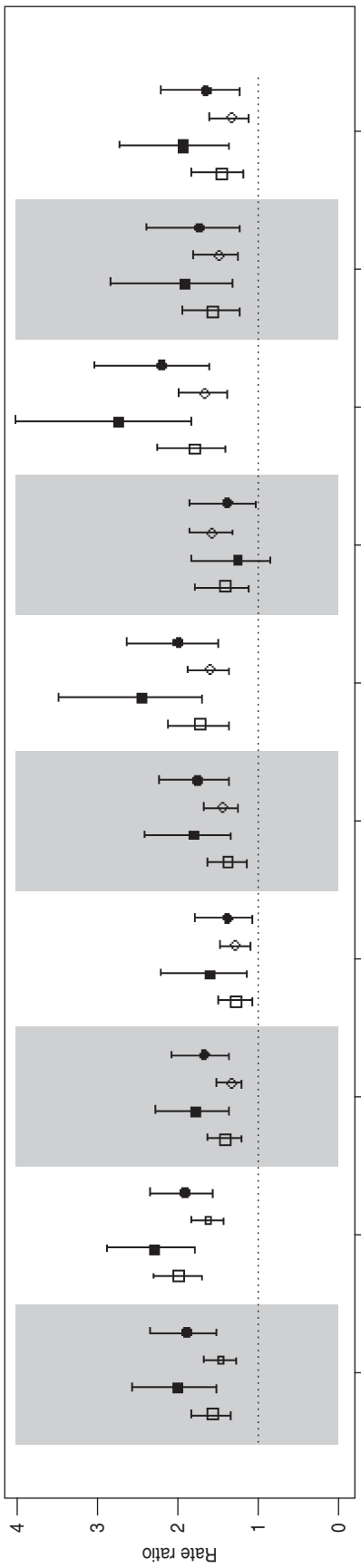

Fig. 2. Age- and sex-standardized rate ratio and 95% confidence intervals for all ages and for analysis restricted to those aged <20 years for each influenza season. Asterisk (*) indicates influenza seasons in which the vaccine conferred little protection. □, All ages ($n=487$); ■, <20 years ($n=487$); ○, All ages ($n=486$ and 487); ●, <20 years ($n=486$ and 487).

through visits to ambulatory care settings. Moreover, they used community controls for socioeconomic conditions and geographic location to show that the higher rates in aboriginals persisted even after controlling for these factors [17]. Therefore, it is conceivable that rates of OC/ED visits from residents of Kahnawá:ke are not substantially greater than residents of neighbouring regions, given a similar burden of disease.

Although we standardized by age and sex, we did not have access to measures of household composition, size and crowding; factors that could potentially effect influenza transmission rates [12, 42, 43]. However, unlike many First Nations reserves that have relatively poor living conditions and large paediatric populations (www.ainc-incac.gc.ca), socioeconomic conditions in Kahnawá:ke are favourable and the age distribution of the population is similar to adjacent regions. Thus, it is unlikely that community differences in these factors can account for the elevated rates in Kahnawá:ke.

Despite there being accessible healthcare in Kahnawá:ke and socioeconomic conditions comparable to those of our reference region, we found a marked increase in rates of influenza-related OC/ED visits from residents of Kahnawá:ke, particularly in the young. The elevated rates in Kahnawá:ke's youth suggest that factors other than a high prevalence of chronic disease may be related to influenza risk. In light of our findings, further study is needed to identify the more important risk factors that contribute to the increased rates of influenza in aboriginal peoples.

NOTE

Supplementary material accompanies this paper on the Journal's website (http://journals.cambridge.org/hyg).

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DECLARATION OF INTEREST

None.

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