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# Characterising risk of homicide in a population-based cohort

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## ABSTRACT

**Background** Homicide is an extreme expression of violence that has attracted less attention from public health researchers and policy makers interested in prevention. The purpose of this study was to examine the socioeconomic gradient of homicide and to determine whether risk differs by immigration status.

**Methods** We conducted a population-based cohort study using linked vital statistics, census and population data sets that included all deaths by homicide from 1992 to 2012 in Ontario, Canada. We calculated age-adjusted death rates for homicide by material deprivation quintiles, stratified by immigration status. Count-based negative binomial regression models were used to calculate unadjusted and adjusted rate ratios with predictors of interest being age, urban residence, material deprivation and immigration status. A subanalysis containing immigrants only examined the effect of time since immigration and immigration class.

**Results** There were 3345 homicide deaths registered between 1992 and 2012. Relative to low material deprivation areas, age-adjusted rates of homicide deaths in high materially deprived areas were similar among refugees (RR: 48.49; 95% CI 36.99 to 62.45) and long-term residents (RR: 47.67; 95% CI 44.66 to 50.83), but were slightly lower for non-refugee immigrants (RR: 38.53; 95% CI 32.42 to 45.45). Female refugees experienced a 1.31 (95% CI 0.88 to 1.94) higher rate and male refugees experienced a 1.23 (95% CI 0.90 to 1.67) higher rate of homicide victimisation compared with long-term residents. In an immigrant only analysis, the risk of homicide among refugees increased with duration of residence.

**Conclusions** Given the large area-level, socioeconomic status gradients observed in homicides among refugees, community-level and culturally appropriate prevention approaches are important.

## INTRODUCTION

Homicide is a largely preventable cause of premature death and an extreme expression of violence that has received little attention among health research and policy makers in Canada.<sup>1 2</sup> Several risk factors have been identified for being a victim of homicide, which include being a late teen or young adult,<sup>3</sup> male sex,<sup>3</sup> low socioeconomic status (SES),<sup>4</sup> income inequality,<sup>3</sup> race/ethnicity,<sup>5 6</sup> access to a firearm in the home<sup>7</sup> and involvement in organised crime.<sup>3</sup> Other social vulnerabilities, including immigrant and refugee status, have been less well studied and their influence on risk of homicide victimisation is poorly understood.<sup>8 9</sup> The selective nature of Canada's immigration policies result in

an immigrant population with an overrepresentation of relatively young, healthy, educated and economically active people, who tend to experience better health outcomes than their Canadian-born peers—this phenomenon is known as the 'healthy immigrant effect'.<sup>10</sup> However, it is unknown whether this effect applies to causes of death such as homicide, or whether these protective effects extend to refugees.

Canada has one of the highest immigrant populations (21.9%) in the world, with about half of all immigrants residing in the province of Ontario.<sup>11</sup> The majority of immigrants to Canada are economic or family class immigrants, who must demonstrate reasonable health and ability to contribute to Canada's economy. Ten per cent of immigrants are admitted as refugees, and are assessed on different criteria.<sup>11</sup> Refugees are known to differ from other immigrants on the basis of educational and economic status, linguistic capacity, migration experiences and exposure to adversity and trauma in their country of origin.<sup>12</sup> Further, immigrant or refugee status is an established social determinant of health, which is strongly associated with mortality, disease onset, and access to and quality of healthcare services.<sup>13 14</sup>

Homicide victimisation can be influenced by factors that are more prevalent in immigrant communities including social isolation, cultural attitudes, gender roles, predisposition to violence and fewer employment options.<sup>15</sup> The relationship between sex and homicide demonstrate that males are at an increased risk, particularly in relation to organised crime.<sup>3</sup> However, differing patterns by sex among the immigrant population warrants further exploration given that female immigrants may face unique vulnerabilities for violence including low levels of community supports, absence of appropriate services, cultural views on gender, fear of deportation or losing custody of children and legal factors.<sup>16</sup> We further hypothesise that there may be an SES gradient in homicide that differs by immigration status due to different economic opportunities available to recent immigrants and refugee populations.<sup>17</sup>

To date, very few Canadian studies have examined population level risk factors for homicide and none have explicitly focused on immigrants and refugees. The purpose of the present study was to use comprehensive multilinked mortality files from Ontario to examine the socioeconomic gradient of homicide and to determine whether the risk of death differs by immigration characteristics. These



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objectives were examined separately for males and females to account for sex differences in socioeconomic effects. Risk was also evaluated by immigration class, including refugees and duration of residence.

## METHODS

### Study design

This population-based cohort study took place in Ontario, Canada's most populous province, which historically has experienced the greatest number of homicides in Canada.<sup>18</sup> Included were all Ontario males and females whose deaths were registered as homicide between 1 January 1992 and 31 December 2012 and which could be linked to a valid record in the Registered Persons Database (RPDB). Deaths were linked at ICES to multiple population-based databases containing socioeconomic, demographic and immigrant status information.

### Data sources

We linked several provincial-level administrative datasets to determine the cohort, outcomes and additional study variables. These datasets were linked using unique, encoded health identification numbers and analysed at ICES. Specifically, demographic information at time of death, including birth date, sex and postal code for all Ontario residents was obtained from the RPDB, a central population registry file of all those eligible for Ontario's health insurance plan since April 1991, which enables linkage with other ICES datasets.

Mortality data were obtained from the Ontario Registrar General's death file (ORG-D), which contains death records for the province of Ontario since January 1990. ORG-D is based on Medical Certificates of Death files in Ontario, and contains cause of death information coded using the International Classification of Disease ninth and 10th revisions with Canadian enhancements (ICD-9/10-CA). The overall linkage rates for the ORG-D and the RPDB are 96.2%.<sup>19</sup> We used the Ontario segment of the Immigration, Refugees and Citizenship Canada's permanent resident database (IRCC) to ascertain immigrant status. IRCC contains detailed information for immigrants to the province from 1985 to 2017, including their refugee status and date of immigration. Approximately 86% of IRCC records are successfully linked to the RPDB by deterministic or probabilistic matching.<sup>19</sup>

SES was assessed using the Ontario Marginalization Index (ON-Marg)<sup>20</sup> which is available for 2001, 2006 and 2011 census years. Therefore, 2001 Census-derived values were used for the period of 1992–2003, 2006 values were used for the period of 2004–2008, and 2011 values were used for the period of 2009–2012. ON-Marg is an area-level index of socioeconomic indicators, and has been previously validated for health research use in Ontario.<sup>21</sup> Among ON-Marg indicators, material deprivation which combines information from income and education, has the strongest association with health outcomes.<sup>21</sup> Additionally, we used another dimension of ON-Marg, known as ethnic concentration, which is a measure of the proportion of recent immigrants and of people who self-identify as a visible minority. Using the nearest census ON-Marg data, each death record in our cohort was assigned to a provincial quintile of material deprivation and ethnic concentration according to their RPDB postal code at death, using Statistics Canada's Postal Code Conversion File Plus.<sup>22</sup>

We used Statistics Canada Postal Code Conversion File Plus to link individual postal codes to derive area-level neighbourhood income quintiles from the Canadian census.<sup>22</sup> Rurality at time of

death was determined by the Rurality Index of Ontario (RIO) score.<sup>23</sup> The RIO score uses postal codes to assign a score on a 100-point scale, with a score of 40 or greater representing rural residence.

### Outcomes

For the analysis, we extracted all homicides between 1 January 1992 and 31 December 2012. Homicides were classified using the three-digit International Classification of Diseases code (ICD9: E960-969/ICD10: X85-X99, Y00-Y09, Y87.1).

### Immigration status

Immigrants were grouped according to admission class as either refugees or non-refugee immigrants. Refugees included government-assisted refugees, privately sponsored refugees, refugees landed in Canada, refugee dependents and blended visa office-referred refugees, as defined by IRCC.<sup>24</sup> For the purposes of this study, all other individuals were considered long-term residents. This long-term resident group consisted largely of individuals born in Canada and contained a small number of immigrants where record linkage between the RPDB and IRCC was not possible, or who arrived in Canada prior to January 1985. In additional analyses, immigrants were further classified by duration of residence in Canada at time of death ( $\geq 10$  years, 5–9 years, or  $< 5$  years).

### Statistical analysis

Baseline sociodemographic characteristics were examined across homicide deaths, stratified by sex. Age-adjusted death rates for the study period per 100 000 persons and associated 95% CIs were calculated by material deprivation, stratified by immigration status using the age distribution of Ontario in 2000. We modelled rates between males and females, using a count-based negative binomial regression model. Unadjusted and adjusted rate ratios (RRs) and 95% CIs were generated. Adjusted RRs were adjusted for age group ( $< 18$ , 18–24, 25–44, 45–54,  $\geq 55$ ), material deprivation quintile, immigrant status and rurality.

A separate regression model was built for immigrants only where we modelled homicide rates adjusting for sex, age group ( $< 18$ , 18–24, 25–44, 45–54,  $\geq 55$ ), and material deprivation. Rurality was not adjusted for in the immigrant only model because  $< 5\%$  of the immigrant population resided in rural areas. We followed strict privacy guidelines set out by ICES for use of health administrative data for health research without individual consent. Institutional policy requires suppression of cell sizes of less than six to ensure non-identification. All analyses were performed in SAS V.9.4.

### Sensitivity analysis

As a sensitivity analysis, deaths classified as undetermined intent (ICD9: E980-989/ICD10: Y10-Y34) were included on the basis that a portion may be misclassified homicides.<sup>25 26</sup> Deaths are classified as undetermined intent if the intentionality remained unclear after the medical and coroner examination due to insufficient information.

## RESULTS

### Sociodemographic characteristics of homicide deaths

There were 3345 homicide deaths captured during the study period (table 1). The average age of death for males was about 3 years younger than females. In comparison to females, a slightly higher proportion of non-refugee immigrants who died by

**Table 1** Baseline characteristics of the study population at the time of death by sex, Ontario, Canada, 1992–2012

Characteristic	Homicide (n=3345)			
	Female (n=1043)		Male (n=2302)	
	N	%	N	%
Age (years) (mean (SD))	38.00 (20.9)		34.54 (17.6)	
<18	158	15.2	226	9.8
18–24	123	11.8	562	24.4
25–44	402	38.5	916	39.8
45–54	144	13.8	280	12.2
≥55	216	20.7	318	13.8
Immigrant status				
Refugee	31	3.0	89	3.9
Non-refugee immigrant	93	8.9	273	11.9
Long-term resident	919	88.1	1940	84.3
Urban residence				
Yes	911	87.3	1984	86.2
No	67	6.4	123	5.3
Income quintile				
1 (lowest)	319	30.6	928	40.3
2	209	20.0	464	20.2
3	179	17.2	330	14.3
4	142	13.6	256	11.1
5 (highest)	150	14.4	191	8.3
Material deprivation				
1 (least deprived)	132	12.7	186	8.1
2	135	12.9	223	9.7
3	157	15.1	344	14.9
4	230	22.1	478	20.8
5 (most deprived)	311	29.8	860	37.4
Ethnic concentration				
1 (least concentrated)	167	16.0	267	11.6
2	156	15.0	272	11.8
3	182	17.5	312	13.6
4	167	16.0	381	16.6
5 (most concentrated)	293	28.1	859	37.3

homicide were male (11.9% of males compared with 8.9% of females). A higher proportion of male homicide victims lived in neighbourhoods classified as being in the lowest income quintile, in contrast to females (40.3% of males compared with 30.6% of females). In comparison to females, a higher proportion of male homicide deaths occurred among residents living in the most ethnically concentrated areas (37.3% of males compared with 28.1% of females). As part of a sensitivity analysis, baseline characteristics of deaths due to undetermined intent can be found in online supplementary table S1.

**Deaths by homicide and SES**

Figure 1 presents the age-adjusted rate of homicide relative to material deprivation by refugees, non-refugee immigrants and long-term residents. The results show that the mortality rate for homicide according to high material deprivation (quintile 5) was slightly higher among refugees than long-term residents and non-refugee immigrants. In the least deprived quintiles (1–3), the rate of homicide victimisation among refugees exceeded that of long-term residents. Overall, the age adjusted mortality rate was higher with

increasing material deprivation quintile (ie, among low SES groups).

Table 2 shows the sex-specific regression model for homicide with unadjusted and adjusted RRs. Adjusting for age, material deprivation, immigrant status and rurality, death by homicide for those in the 18–24 age range, compared with those 55+, was 1.50 (95% CI 1.16 to 1.94) times more likely for females and 4.54 (95% CI 3.43 to 6.02) times more likely for males.

In the unadjusted model, refugees had a higher risk in comparison to long-term residents; the crude RR was 1.87 (95% CI 1.31 to 2.68) for females and 1.83 (95% CI 1.48 to 2.27) for males. The association was attenuated after adjustment for age, material deprivation, immigrant status and rurality with a 1.31 (95% CI 0.88 to 1.94) increased risk for females and a 1.23 (95% CI 0.90 to 1.67) increased risk for males, and a CI that included the null value.

Urban residence was positively associated with death by homicide among females (RR: 1.34; 95% CI 1.02 to 1.77) and males (RR: 1.50; 95% CI 1.16 to 1.94), in comparison to rural residence. Residing in the highest deprivation quintile was associated with a higher likelihood of death by homicide among females (RR: 2.41; 95% CI 1.90 to 3.06) compared with the least deprived quintile, and the social gradient was even more pronounced for males (RR: 4.11; 95% CI 3.06 to 5.52).

**Immigrant only subgroup analysis**

When we restricted the analysis to immigrants only to quantify the impact of time since immigration, the RRs for homicide increased by duration of residence in Ontario (figure 2). Refugees were much more likely to die by homicide in comparison to non-refugee immigrants. For the full table of estimation see online supplementary table S2.

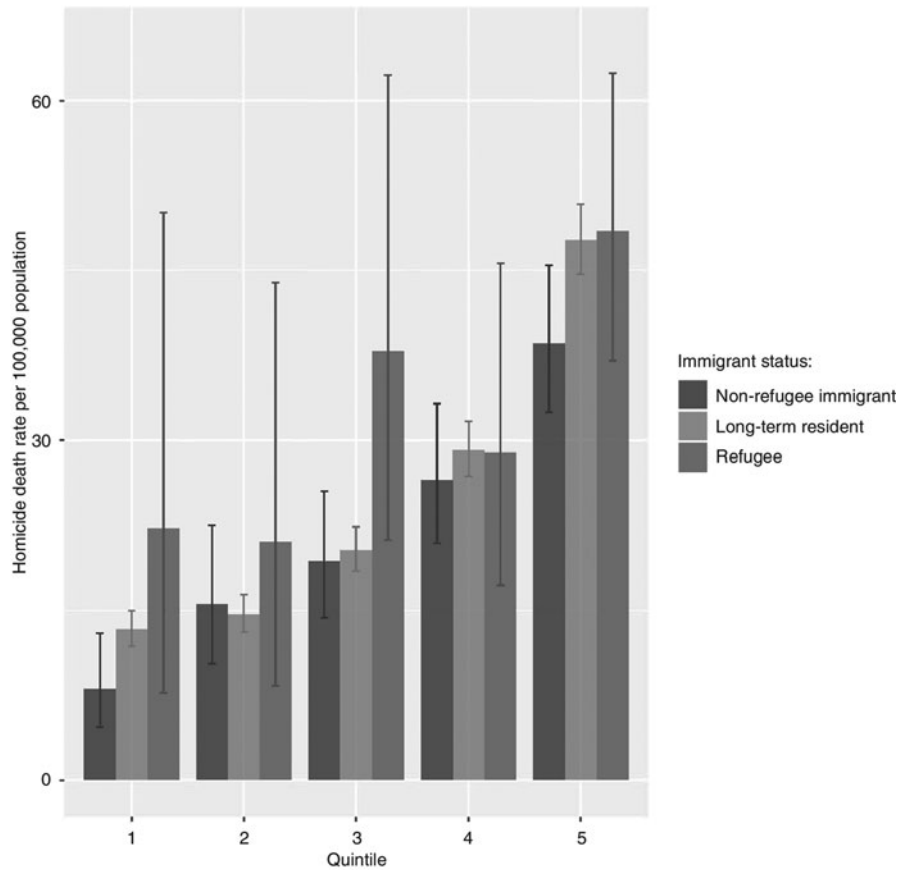
**Sensitivity analyses**

In a sensitivity analysis, we examined the effect of age group, urban residence, immigrant status and material deprivation on deaths of undetermined intent (see online supplementary table S3). The strength of the effect estimates for material deprivation closely resemble that of homicide. Risk of death by undetermined intent was greatest in the 45–55 age group for both females (RR: 1.60; 95% CI 1.38 to 1.84) and males (RR: 1.65; 95% CI 1.38 to 1.97) compared with the reference group of 55. Being a refugee or non-refugee immigrant was associated with a reduced risk in comparison to long-term residents (RR female: 0.28; 95% CI 0.14 to 0.54; RR male: 0.58; 95% CI 0.42 to 0.81). Finally, as levels of material deprivation increased for both sexes, the risk of undetermined death also increased (RR females: 3.35 (2.80–4.01); RR males: 2.71 (2.16–3.40).

**DISCUSSION**

This population-based cohort study characterised homicide rates according to the socioeconomic gradient of homicide with a focus on risk among immigrants by admission class (refugee and non-refugee immigrant) and duration of residence. Our main results show that female and male refugees have a higher rate of homicide victimisation compared with long-term residents. When examining an immigrant only subset, refugees were at an increased risk of homicide victimisation compared with non-refugee immigrants. The risk of homicide increased with duration of residence in Canada.

To our knowledge, this is the first Canadian study to explore homicide risk among immigrants by immigration class and duration of residence. Interestingly, our finding that female



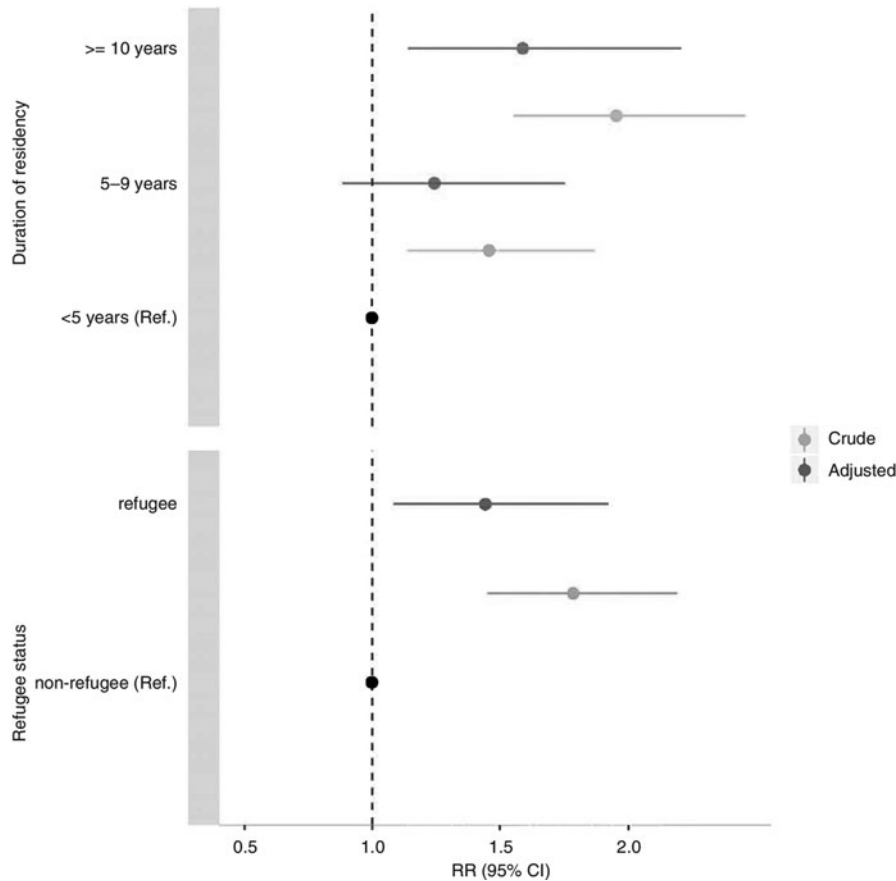
**Figure 1** Age adjusted homicide death rate (per 100 000 persons) in Ontario by material deprivation and immigration status, 1992–2012 combined.

immigrants were at a lower risk for homicide is different from prior European studies, which found a higher homicide rate among female migrants.<sup>27–29</sup> However, these prior studies

differed in the methods used to conceptualise immigrants, often considering immigrants as a whole or focusing on ethnicity. We suspect that the inability to consider the effect of refugee status

**Table 2** Unadjusted and multivariable sex-specific regression models of homicide, adjusting for age group, urban residence, immigrant status and material deprivation

Parameter	Unadjusted rate ratio (95% CI)		Adjusted rate ratio (95% CI)	
	Female	Male	Female	Male
<b>Age group</b>				
<18	0.82 (0.67 to 1.01)	0.65 (0.54 to 0.77)	0.78 (0.61 to 1.00)	0.63 (0.46–0.86)
18–24	1.61 (1.29 to 2.01)	4.11 (3.58 to 4.72)	1.50 (1.16 to 1.94)	4.54 (3.43–6.02)
25–44	1.47 (1.24 to 1.73)	1.93 (1.70 to 2.19)	1.44 (1.17 to 1.76)	1.76 (1.35–2.31)
45–55	1.14 (0.92 to 1.41)	1.29 (1.10 to 1.52)	1.15 (0.90 to 1.47)	1.27 (0.94–1.70)
≥55	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
<b>Urban residence</b>				
Yes	1.15 (0.90 to 1.47)	1.40 (1.17 to 1.69)	1.34 (1.02 to 1.77)	1.50 (1.16–1.94)
No	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
<b>Immigrant status</b>				
Refugee	1.87 (1.31 to 2.68)	1.83 (1.48 to 2.27)	1.31 (0.88 to 1.94)	1.23 (0.90–1.67)
Non-refugee immigrant	0.84 (0.68 to 1.05)	1.24 (1.09 to 1.40)	0.74 (0.58 to 0.93)	0.90 (0.72–1.13)
Long-term resident	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
<b>Material deprivation</b>				
1 (least deprived)	1.00 (reference)	1.00 (reference)	1.00 (reference)	1.00 (reference)
2	1.05 (0.83 to 1.34)	1.22 (1.01 to 1.48)	1.07 (0.82 to 1.40)	1.30 (0.93–1.82)
3	1.23 (0.98 to 1.55)	1.88 (1.58 to 2.25)	1.23 (0.94 to 1.60)	2.01 (1.47–2.75)
4	1.79 (1.45 to 2.22)	2.62 (2.21 to 3.10)	1.83 (1.44 to 2.34)	2.59 (1.91–3.51)
5 (most deprived)	2.38 (1.94 to 2.92)	4.63 (3.95 to 5.42)	2.41 (1.90 to 3.06)	4.11 (3.06–5.52)



**Figure 2** Risk of homicide by duration of residence and by refugee status, restricted to immigrants to Ontario (homicide n= 486).

inflated the level of risk observed in immigrants as a whole. Another study in adults that examined the effect of different classes of immigrants identified an association between refugee status and homicide in immigrants to Denmark.<sup>9</sup> Although the results are based on small numbers, similarly to our observations, they found that risk of homicide was greater in the refugee population and more specifically, higher among female refugees than male refugees.<sup>9</sup> Part of the explanation as to why female refugees have a higher risk of homicide may be due to barriers in accessing supports when experiencing intimate partner violence. While existing research suggests that intimate partner violence isn't more common among refugees, there is evidence that immigrants and refugees face greater barriers to accessing supports due to language, fear of discrimination/racism and economic vulnerability, which may lead to a more lethal outcome.<sup>30</sup>

Our results confirm the presence of a healthy immigrant effect among non-refugee immigrants, whereby Canada's immigration selection policies, which target healthy and highly educated individuals, confer protection against homicide. This research also highlights the need to recognise contextual factors such as immigration characteristics (ie, refugee status, time since immigration) as important for understanding the heterogeneity of immigrants as a whole and their risk for homicide victimisation more broadly.<sup>31</sup> Despite the immigrant health advantage, research shows that immigrant populations are over-represented in low-income groups, relative to non-immigrants<sup>32</sup> with many facing barriers in access to health services, unemployment and housing instability.<sup>33</sup>

The barriers that immigrants face on arrival often occur more frequently among refugee populations, which can further exacerbate adverse health outcomes produced by a history of violence,

trauma and torture.<sup>34-36</sup> In addition, the stresses of immigration and acculturation have been associated with depression and psychosocial illness, particularly in vulnerable populations such as refugees.<sup>37-38</sup> Together these findings in the context of our current understanding highlight the importance of providing diverse social supports and resources (ie, adequate housing, employment and training opportunities, trauma counselling and mental health services, access to a translator) as protective factors against homicide, specifically among refugee populations.

**Strengths and limitations**

Strengths of this study include the use of population-level data sets (ORG-D) that encompass every death due to homicide and undetermined intent that occurred over the study period. Detailed information including immigration class and landing date with systematic and uniform data collection distinguishes this study from other small homicide registry studies<sup>28</sup> or other population-based immigrant homicide studies that lacked detailed immigration data.<sup>27-28</sup> Results of our study are likely generalisable to other countries with a similarly large and heterogeneous immigrant population (eg, UK, Australia).<sup>31-39</sup> Given that there is evidence to suggest deaths of undetermined intent may include a proportion of homicides,<sup>25-26</sup> a sensitivity analysis was undertaken and found that the socioeconomic gradient of deaths of unknown intent were similar to homicide. Our team has previously shown that at least a proportion of undetermined intent deaths may be misclassified suicides, which likely contributes to the discrepancies identified (ie, different high-risk age groups) in the analysis.<sup>40</sup>

The results should also be interpreted in context of the study limitations. Due to the nature of the IRCC Permanent Resident database, some immigrants may have been misclassified as long-term residents, including those who arrived prior to 1985 and those who landed outside Ontario. Nonetheless, those who immigrated prior to 1985 would have resided in Canada for at least 18 years prior to the initiation of the study period and research demonstrates that over the years of residence, the socio-economic characteristics and health of immigrants tend to resemble that of the Canadian-born population.<sup>41</sup> We employed an area-based measure of SES rather than an individual-level measure; however, area-based measures of SES are associated with health status,<sup>42</sup> and produce similar findings as individual-level measures when the geographic regions are small.<sup>43</sup> Results of our study may not be generalisable to temporary or undocumented immigrants and refugees seeking asylum without permanent residency status, as these immigrants are not currently linkable with existing databases. In an effort to maximise our sample size we included all homicide deaths over the period of 1992–2012, however, given that homicide is a rare outcome we were limited in precision of some estimates, especially when stratifying by multiple variables. While both sex-specific adjusted models did not reach statistical significance, the strength of association is large and the unadjusted model results were statistically significant. Moreover, according to Kaufman, these findings are meaningful in the context of immigration as they provide a true depiction of the unadjusted racial disparities that exist.<sup>44</sup>

## CONCLUSIONS

Our results suggest that female and male refugees have a higher risk of homicide in comparison to long-term residents and non-refugee immigrants. Given that Canada is currently experiencing a rapid growth in the population of immigrants, one of the highest rates of any Western nation,<sup>39</sup> the role that immigration factors play in contributing to homicide is increasingly important. Population-based public health interventions can effectively reduce these types of violent outcomes<sup>45 46</sup>; however, we have identified a need for more targeted interventions for refugees in Canada where social vulnerabilities and cultural differences may be contributing to risk of victimisation.

### What is already known on this subject

- ▶ Homicide is a largely preventable cause of premature death and an extreme expression of violence.
- ▶ Social vulnerabilities, including low socioeconomic status (SES) and income inequality have been recognised as important contributors to risk of homicide and have become targets for population-based prevention strategies.

### What this study adds

- ▶ There are large area-level SES gradients observed with risk of homicide victimisation by immigrant status.
- ▶ Female and male refugees have a higher risk of homicide in comparison to long-term residents and non-refugee immigrants.
- ▶ Refugees have been identified as a population in need of targeted interventions to reduce risk of homicide victimisation.

**Correction notice** This article has been corrected since it first published. Changes have been made to the references.

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**Author note** In 2018, the Institute formerly known as the Institute for Clinical Evaluative Sciences formally adopted the initialism ICES as its official name.

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