

## Characterising mental health and addictions and assault-related health care use in the year prior to death: a population-based linked cohort study of homicide victims

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### Abstract

#### Introduction

Homicide is an important cause of death for older youth and adult Canadians; however, little is known about health care use prior to death among this population.

#### Objectives

To characterise health care use for mental health and addictions (MHA) and serious assault (herein referred to as assault) one year prior to death among individuals who died by homicide in Ontario, Canada using linked mortality and health care utilisation data.

#### Methods

We report rates of health care use for MHA and assault in the year prior to death among all individuals 16 years and older in Ontario, Canada, who died by homicide from April 2003 to December 2012 (N = 1,541). Health care use for MHA included inpatient stays, emergency department (ED) visits and outpatient visits, whereas health care use for assault included only hospital-based care (ED visits and inpatient stays). Sociodemographic characteristics and health care utilisation were examined across homicide deaths, stratified by sex.

#### Results

Overall, 28.5% and 5.9% of homicide victims sought MHA and assault care in the year prior to death, respectively. A greater proportion of females accessed care for MHA, whereas a greater proportion of males accessed assault-related health care. Males were more likely to be hospitalised following an ED visit for a MHA or assault related reason, in comparison to females. The most common reason for a MHA hospital visit was for substance-related disorders. We found an increase over time for hospital-based visits for assault prior to death, a trend that was not observed for MHA-related visits.

#### Conclusions

A large proportion of homicide victims interacted with the health care system for MHA or assault in the year prior to death. An increase in hospital-based visits for assault-related reasons prior to death was observed. These trends may offer insight into avenues for support and prevention for victims of homicide.

#### Keywords

violence; cohort study; descriptive epidemiology; health services; mortality

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## Introduction

Homicide is among the leading causes of death for Canadians 35 years and younger [1]. Risk of homicide is multifaceted and influenced by factors acting at the individual, interpersonal, community, and societal levels [2]. As a large contributor to premature mortality, disability, and injury, violence has been progressively recognised as a public health issue that demands greater investment in prevention [2, 3].

Individuals with mental health conditions have shown to be at increased risk of homicide compared to the general population [4–9]. This increased risk may be related to neighbourhood-level conditions [10], socioeconomic deprivation (e.g., unemployment, inadequate housing, limited social support) [11] or potential for victimisation due to stigma and discrimination [11, 12]. Prior literature has suggested that a sizeable proportion of victims of violence are seen in the health care system prior to their death. One US study found that 44% of domestic homicide victims were seen in the emergency department (ED) within two years of the homicide incident, predominately for assault-related reasons [13]. Research on victims of domestic homicide has suggested a considerable proportion experience physical violence prior to the lethal incident [14, 15], which has been supported by coroner examination [13, 16].

To the best of our knowledge, no studies have examined health care use prior to homicide in Canada. While some studies have described interactions between homicide victims and health care systems, they have been limited to a focus on specific types of homicide (i.e. intimate partner homicide) [13, 17], population sub-groups including youth [18] or people experiencing homelessness [19], have relied on questionnaires and self-reported data [17, 20], or utilised small regional samples [9, 13, 17].

Our population-based study aimed to characterise MHA and serious assault necessitating a hospital visit (herein referred to as assault) in the year prior to death among individuals 16 years of age and older who died by homicide in Ontario, Canada, between 2003 and 2012. Describing the extent of hospital-based and outpatient visits as a point of care is an important initial step in guiding services and interventions for this group at high risk of lethal outcomes.

## Methods

### Study design and population

We conducted a cohort study using population-level health administrative data captured in Ontario, Canada. The province of Ontario is Canada's largest by population, with approximately 14.7 million people as of 2020 [21]. In Canada's universal health care system, legal residents are eligible for publicly funded physician, emergency department (ED) and hospital-based care. Data collected routinely through the provision of insured care are linked across databases via the Registered Persons' Database (RPDB) and allow longitudinal investigation of health care use over time.

Our study population included all Ontario residents aged 16 and older whose deaths were registered as a homicide between April 1, 2003 and December 31, 2012 and which

could be linked to a valid record in the RPDB. We excluded individuals who were less than 16 years of age due to the differing nature of health care visits, treatment availability, and care-seeking behavior for assault- and MHA-related care [22]. We identified homicide deaths using the International Classification of Diseases (ICD) codes (ICD10: X85-X99, Y00-Y09, Y87.1).

### Data sources and variables

We used several linked provincial-level administrative datasets to create the study cohort and capture health care use and additional study variables. These datasets were linked using unique encoded health identification numbers and analyzed at ICES. ICES is an independent, non-profit research institute whose legal status under Ontario's health information privacy law allows it to collect and analyze health care and demographic data, without consent, for health system evaluation and improvement.

### Demographic variables

The study cohort was linked to Ontario's central population registry, the Registered Persons Database (RPDB), permitting linkages with other data sets. The RPDB captures demographic information, including birth date, sex, and postal code at the time of death, for all residents eligible for OHIP (Ontario Health Insurance Plan). Death records for the province were captured by the Ontario Office of Registrar General's Deaths file (ORG-D) and are based on the Medical Certificates of Death containing cause of death information coded using the 3-digit ICD Tenth Revision with Canadian enhancements (ICD-10-CA). The overall linkage rate between ORG-D and the RPDB is 96.2% [23].

### Socioeconomic and area-based measures

Individuals were linked to data from the Ontario Marginalisation Index (ON-Marg), which is a validated measure of socioeconomic status (SES) and was used to capture material deprivation [24]. Based on area-level census characteristics, individuals were assigned to provincial quintiles of material deprivation, derived from characteristics including income, education, quality of housing and family structure. ON-Marg quintiles were assigned at the level of dissemination areas, the smallest census geography for which characteristics are reported, most of which have a population of between 400 and 700. Dissemination areas are categorised into quintiles with quintile 1 representing the least marginalised areas (highest SES) and quintile 5 representing the most marginalised areas (lowest SES). Statistics Canada's Postal Code<sup>OM</sup> Conversion File Plus (PCCF+) [25] was used to determine the decedents' dissemination area based on postal code at death. ON-Marg scores were then assigned, based on the nearest census: scores for the 2001 census were used for deaths in the year 2003, scores from the 2006 census were used for deaths from 2004–2008, and scores from the 2011 census were used for deaths from 2009–2012. Statistics Canada's PCCF+ was also used to derive neighbourhood income quintiles at the dissemination area level. Dissemination areas were allocated to an area-level income quintile according to the nearest-census

household income of the residents of that neighbourhood. Rurality at the time of death was assigned using the Rurality Index of Ontario [26], which is a continuous measure of rurality that uses census areas to assign a score on a 100-point scale, with a score of 40 or more indicating rural residence. To measure publicly funded health care utilisation, we used linked administrative data from Ontario's universal health care system that encompasses hospital-based acute care and physician services. Information on outpatient visits was obtained from OHIP, ED visits were identified using the National Ambulatory Care Reporting System (NACRS), and information on inpatient hospitalisations was obtained from the Canadian Institute for Health Information Discharge Abstract Database (CIHI-DAD) and Ontario Mental Health Reporting System (OMHRS).

### Health care use for mental health and addictions

Publicly funded MHA included all inpatient stays, ED visits, and outpatient visits for a MHA-related reason, according to the framework proposed by the Mental Health and Addictions Scorecard and Evaluation Framework Research Team at ICES [27]. Inpatient stays were identified using the ICD-10-CA, while inpatient stays in a provincially designated mental health hospital bed were captured using the fourth edition of the Diagnostic and Statistical Manual of Mental Disorders. MHA ED visits were captured according to the classification system as inpatient stays. MHA in hospital settings (inpatient stays and ED visits) was further sub-classified into substance use disorders, schizophrenia, mood and affective disorders, anxiety disorders, deliberate self-harm and other based on diagnostic categories.

MHA-related outpatient visits to primary care providers included all office, home, and long-term care billings made by psychiatrists, family physicians or pediatricians with a corresponding diagnostic code (see Supplementary Appendix 1 for diagnostic codes). This definition is based on a modified algorithm for ambulatory mental health care, the validated original form of which was shown to result in 96.1% sensitivity and 93.1% specificity when compared with chart-abstracted data [28].

### Health care use for assault

Assault-related health care use included all hospital-based care according to the cause of injury framework proposed by the US Centres for Disease Control and Prevention as well as the Canadian ICD-10 coding standards (X85-Y09, Y87.1) to capture morbidity and mortality from assault [29]. Assault-related visits were further sub-classified as assault by a sharp or blunt object, bodily force, assault by firearms, and other assaults, based on the mechanism of assault. See Supplementary Appendix 2, for codes used to identify health care use for assault.

### Data analysis

Baseline (i.e., date of death) sociodemographic characteristics and health care utilisation were examined across homicide deaths, stratified by sex. The underlying cause of death

recorded in the medical certificate of death is reported by sex. Health care use for MHA included inpatient stays, ED visits and outpatient visits, whereas health care use for assault included only hospital-based care (ED visits and inpatient stays). If an individual had multiple health care encounters in a single day, each encounter was counted for each setting (inpatient, ED and outpatient) to show overall health care burden. However, we did limit individuals to a single visit per day when counting the total days receiving any care. We summed the number of days that each individual had a MHA and/or assault-related care in the year prior to homicide as a measure of total utilisation. To quantify days of care received in the year prior to homicide for MHA and assault, we calculated the proportion of individuals with any health care use and the mean visit length among those with any health care use. We stratified all measures of health care use by sex given that the risk of homicide varies by sex [30, 31] and that we had sufficient sample size to examine health care utilisation. We describe the number of individuals who received health care services for both MHA and assault. We also further describe the type of diagnosis for MHA and the mechanism of injury for assault-related emergency department visits within one year of homicide. We described this information in two ways, including with assault visits that resulted in death included and excluded. All analyses were conducted with SAS software, version 9.3 (SAS Institute Inc., Cary, NC).

## Results

Between April 2003 and December 2012, there were 1,541 homicide deaths registered in Ontario and linked to RPDB (Table 1). On average, male homicide victims were 35 years old and female homicide victims were 44 years old at time of death. The majority of homicides occurred in urban areas and among those that live in more materially deprived neighbourhoods (42.2% in Q5 vs 8.4% in Q1 for males; 28.6% in Q5 vs 15.1% in Q1 for females). There were notable sex differences in the specific underlying cause of death (see Supplementary Appendix 3). Specifically, males were more likely to die by firearms (42.4% among male homicide victims compared to 19.2% among female homicide victims) whereas females were more likely to die due to hanging, strangulation, and suffocation (20.4% among female homicide victims compared to 1.8% among male homicide victims).

### Health care use for mental health and addictions

Overall, 28.5% of homicide victims received care for a MHA reason in the year before death ( $n = 439$ ), amounting to 2,619 total days of care (Table 2). This mostly included outpatient visits with primary care providers and psychiatrists ( $n = 391$ , 25.4%), while a smaller proportion of homicide victims visited the ED ( $n = 99$ , 6.4%) or were hospitalised in an inpatient setting ( $n = 37$ , 2.4%). The majority of outpatient visits were seen by primary care providers. Among female homicide victims, 39.7% had a health care encounter for a MHA-related reason in the year prior to death ( $n = 165$ ). The majority of these visits were outpatient visits ( $n = 149$ , 35.8%), but some females also used ED services ( $n = 33$ , 7.9%) and/or were

Table 1: Baseline characteristics of the study population at the time of homicide by sex, Ontario, Canada, April 2003 to December 2012

Characteristic	Female (n = 416)		Male (n = 1125)	
	N	%	N	%
<b>Age (years) (mean (SD))</b>	44.0(18.7)		35.1(15.9)	
<b>Age Group</b>				
16–24	65	15.6	384	34.1
25–34	90	21.6	279	24.8
35–44	81	19.5	170	15.1
45–54	69	16.6	138	12.3
≥55	111	26.7	154	13.7
<b>Rurality</b>				
Urban	375	90.1	982	87.3
Rural	24	5.8	51	4.5
<b>Income quintile</b>				
1 (lowest)	133	32.0	488	43.4
2	84	20.2	217	19.3
3	68	16.3	157	14.0
4	57	13.7	122	10.8
5 (highest)	63	15.1	88	7.8
<b>Material deprivation</b>				
5 (most deprived)	119	28.6	475	42.2
4	88	21.2	227	20.2
3	66	15.9	132	11.7
2	58	13.9	104	9.2
1 (least deprived)	63	15.1	95	8.4

Table 2: Health care use for mental health and addictions in the year prior to death among individuals who died by homicide (N=1541) from April 2003 to December 2012, by sex

	Female (n = 416)	Male (n = 1125)	Total (n = 1541)
<b>Inpatient care</b>			
Total care days	101	915	1016
Mean visit length per person (days)	8.4	36.6	27.5
≥ 1 visit, n (%)	12 (2.9%)	25 (2.2%)	37 (2.4%)
Total number of visits	12	34	46
<b>Emergency department<sup>1</sup></b>			
Total care days	100	123	223
Mean number of visits per person (days)	3.0	1.9	2.3
≥1 visit, n (%)	33 (7.9%)	66 (5.9%)	99 (6.4%)
<b>Outpatient care</b>			
Total care days	634	802	1436
Mean number of visits per person (days)	4.3	3.3	3.7
≥1 visit, n (%)	149 (35.8%)	242 (21.5%)	391 (25.4%)
<b>Total days receiving any care</b>			
Total care days	820	1799	2619
Mean total care days per person (days)	5.0	6.6	6.0
≥1 visit, n (%)	165 (39.7%)	274 (24.4%)	439 (28.5%)

<sup>1</sup>In the ED setting, 'care days' reflect unique visits to the emergency department, 2 or more of which may take place on the same day.

hospitalised in an inpatient setting for a MHA-related reason (n = 12, 2.9%). Among male homicide victims, 24.4% had a health care encounter for a MHA-related reason in the year prior to death (n = 274). As with females, the majority of

health care use was for outpatient care (n = 242, 21.5%), but some males also accessed ED services, (n = 66, 5.9%) and/or were hospitalised in an inpatient setting for MHA-related reason (n = 25, 2.2%). A greater proportion of ED visits

Table 3: Health care use for assault in the year prior to death among individuals who died by homicide (N = 1541) from April 2003 to December 2012<sup>1</sup>, by sex

	Female (n = 416)	Male (n = 1125)	Total (n = 1541)
<b>Inpatient care</b>			
Total care days	241	1658	1899
Mean visit length per person (days)	9.3	9.9	9.8
≥1 visit, n (%)	26 (6.3%)	167 (14.8%)	193 (12.5%)
Total number of visits	28	176	204
<b>Emergency department<sup>2</sup></b>			
Total care days	63	391	454
Mean number of visits per person (days)	1.1	1.1	1.1
≥1 visit, n (%)	60 (14.4%)	353 (31.4%)	413 (26.8%)
<b>Total days receiving any care</b>			
Total care days	284	1908	2192
Mean total care days per person (days)	4.5	4.9	4.9
≥1 visit, n (%)	63 (15.1%)	386 (34.3%)	449 (29.1%)

<sup>1</sup>Health care use for assault does not encompass outpatient visits.

<sup>2</sup>In the ED setting, 'care days' reflect unique visits to the emergency department, 2 or more of which may take place on the same day.

among males resulted in hospitalisation in comparison to females (21.5% of males compared to 10.0% of females), and hospitalisations in males were longer on average than in females (36.6 days among males compared to 8.4 days among females).

### Health care use for assault

Overall, 29.1% of homicide victims received hospital-based care for assault in the year prior to death (n = 449), amounting to 2192 days of care (Table 3). This was mostly accounted for by ED visits (n = 413, 26.8%), with a smaller proportion of individuals hospitalised in an inpatient setting (n = 193, 12.5%). Among female homicide victims, 15.1% accessed hospital-based care for assault in the year prior to death (n = 63). Approximately 14.4% (n = 60) of females accessed the ED for an assault visit, with a smaller proportion hospitalised for assault-related reasons (n = 26, 6.3%). Among male homicide victims, 34.3% (n = 386) accessed hospital-based care in the year prior to death. Approximately 31.4% (n = 353) of males accessed the ED for an assault visit, with a smaller proportion of males hospitalised in an inpatient setting for an assault-related reason (n = 167, 14.8%). Similar to patterns in mental health care use, a greater proportion of ED visits among males resulted in hospitalisation in comparison to females (22.5% of males compared to 14.3% of females). Overall, 74.6% and 80.6% of hospital-based visits for assault ended in death for females and males, respectively. As a result, 5.9% of homicide victims received hospital-based care for assault and were discharged alive.

### Health care use for both mental health and addictions and assault

Overall, there were 23 (5.5%) females and 119 (10.6%) males who received health care for both MHA and assault in the year prior to death. When we exclude the lethal assault-related

visit, there were 11 (2.6%) females and 49 (4.4%) males who received health care for both MHA and assault in the year prior to death.

### Type of diagnosis for mental health and addictions, and mechanism of injury for assault-related visits

The most common type of diagnosis for a MHA-related ED visit in the year before death was for substance-related disorders (55.2%), whereas the most common mechanism of injury for an assault visit was due to assault by sharp or blunt objects (49.1%) (Figure 1A and Figure 1B). Additionally, the reason for the hospital-based visit for assault was also examined when the visits that resulted in death were removed from the analysis. This resulted in a larger proportion of assaults by less-lethal means, including a greater percent by bodily force and fewer assaults by sharp/blunt objects and by firearm (see Supplementary Appendix 4). We also examined the reason for hospital-based visits with inpatient stays included, and the distribution remained largely unchanged.

Figure 2 shows the number of days from the most recent health care visit (including hospital-based and outpatient care) to homicide for 439 individuals who accessed health care for a MHA-related reason. A small proportion of visits occurred within one week of death (2.7%) with the majority of visits occurring between six months and one year of the homicide (67.0%). The median number of days from the most recent health care use for MHA and death was 254 (IQR: 144-318) days. The median number of days was 257 (IQR: 144-323) and 251 (IQR: 144-315) for females and males, respectively.

Figure 3 shows the number of days from the most recent hospital-based visit for assault to homicide. All individuals who died in hospital as a result of their injuries were seen within a week of their death (n = 358) and are not displayed in Figure 3. Therefore, there were 91 (5.9% of all homicides) individuals who were seen in hospital for an assault-related visit, and were

Figure 1: Type of diagnosis for mental health and addictions (n = 223) and mechanism of injury for assault-related (n = 454) emergency department visits in the year prior to homicide, April 2003 to December 2012

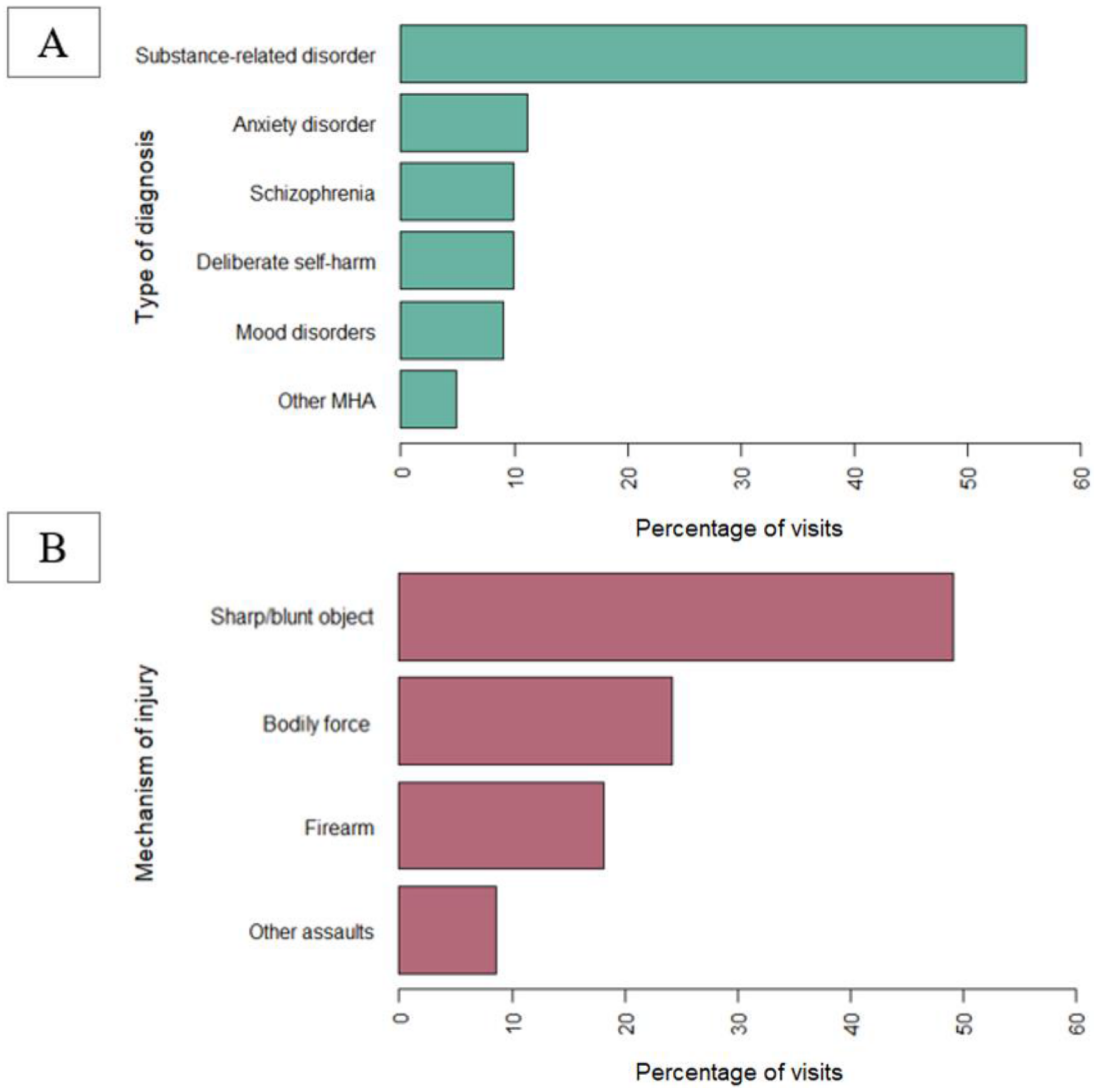


Figure 2: Distribution of mental health and addictions-related visits (N = 439) including hospital-based and outpatient care in the year prior to homicide, April 2003 to December 2012

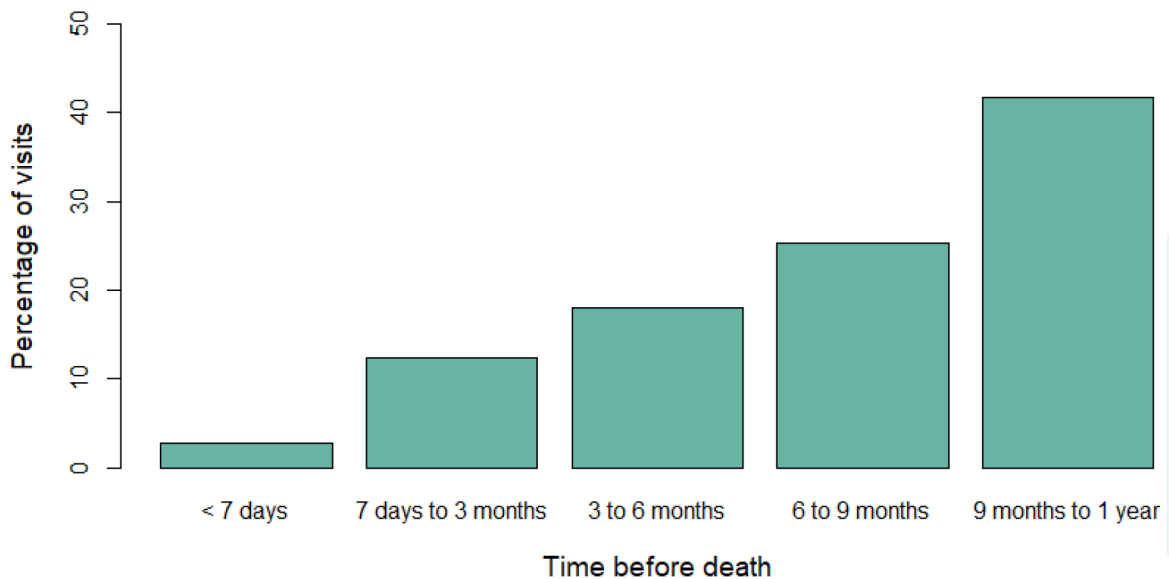
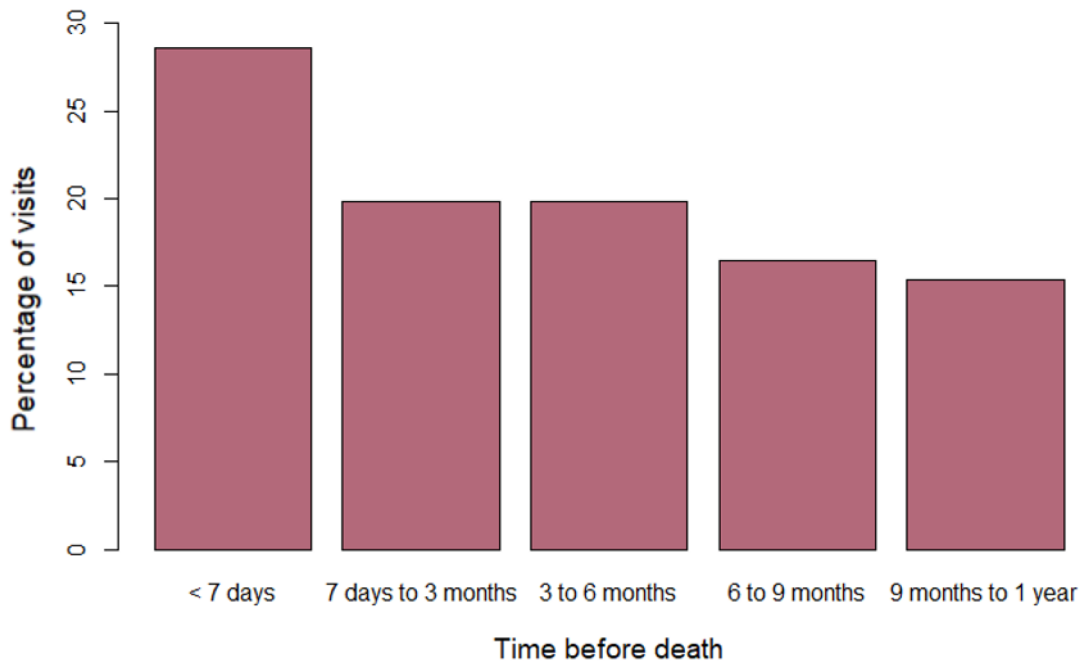




Figure 3: Distribution of hospital-based visits for assault (n = 91) in the year prior to homicide death, April 2003 to December 2012<sup>1</sup>



<sup>1</sup>All individuals who died due to their assault (n = 358) are not displayed.

discharged alive. More than one-quarter, (n = 26; 28.6%) were seen within one week of their death. The median number of days from the most recent hospital-based visits for assault and death was 98 (IQR: 2-212). The median number of days was 89 (IQR:26-114) and 99 (IQR: 2-234) for females and males, respectively.

## Discussion

To our knowledge, this is the largest linked population-based cohort study describing health care use for MHA and assault prior to homicide, utilising a population approach [32]. We observed that males were more likely to die by firearms, whereas females were more likely to die due to hanging, strangulation, and suffocation. We found a substantial number of victims interacted with the health care system prior to their death. Overall, over a third of homicide victims received care for MHA or assault in the year prior to death, respectively. A greater proportion of females accessed care for MHA, whereas a greater proportion of males accessed health care for assault. When males accessed care, their visit was more likely to be severe, resulting in longer inpatient stays or hospitalisation. We found an increase in hospital-based visits for assault, especially within the week prior to death that was not observed with MHA-related visits.

Our study adds to the international literature about MHA and assault-related health care use among individuals who die by homicide. The largest prior study on this topic is a matched case-control study of homicide victims and offenders in the United Kingdom [20]. Similar to our findings, Rodway et al. found that 6% of homicide victims had a MHA-related ED visit one year prior to death, with the most common reason being substance use [20]. In Sweden, a cohort study

found that 22.9% of homicide victims had a MHA-related diagnosis at some point in their lifetime [5]. Few studies have examined temporal trends in health care use prior to the homicide. One statewide US study that reported on ED visits for all causes found almost 10% of people were seen in the ED 6 weeks prior to homicide [33]. While it is difficult to draw direct comparisons due to differences in timing and breadth of health care use captured, when excluding the lethal ED visit, we observed that 5.9% of our cohort were seen specifically for assault, one year prior to death, with just over one-fourth of the visits occurring one week prior to the homicide. Comparisons in health care use among this population may also be a product of differences in health care coverage in these settings, including barriers to care specifically among uninsured or underinsured groups in the United States [34, 35]. Health services research shows that females see their general practitioner more frequently than men [36], which is consistent with our observation that females had higher ambulatory physician use for MHA, whereas acute care visits were more common in males. Our findings that females were more likely to die by hanging, strangulation, and suffocation is consistent with multiple studies that demonstrate this mechanism to be common in intimate partner homicide [37].

A large and growing body of literature suggests that violence is a complex public health problem that may be amenable to population-based primary prevention strategies. Our findings may also have implications for conceptualising secondary prevention approaches in identifying those at risk, given that a large proportion of individuals who become victims of homicide are seen in an outpatient setting for MHA prior to death. This also further supports the importance of awareness for violence prevention strategies in a range of clinical settings rather than only being relevant in high-risk,

acute care environments. Second, the increase in hospital-based visits for assault prior to the homicide incident suggests that patients may benefit from individualised violence intervention approaches. For instance, several US studies have demonstrated success using hospital-based violence intervention programs to provide supports to victims at risk of reinjury [38–41]. These intervention approaches are often referred to as interrupter models involving access to a multidisciplinary team and resources to curb the cycle of violence. An exemplary approach, tailored to the local context, includes a new youth and young adults' violence prevention program implemented in Winnipeg, Manitoba, that has seen a 10% decrease in repeat violent-related injuries [42].

Such secondary prevention approaches should not be considered in isolation but rather in combination with population-based primary prevention strategies to address the socioecological determinants of violence. The social-ecological model provides a framework for conceptualising risk factors and protective factors that contribute to experiencing or perpetrating violence that span across individual, relationship, community, and societal domains [43]. Such strategies at a societal level may include stricter legislation governing public access to guns, such as the newly proposed federal legislation which would ban a range of assault-style guns [44]. Prevention approaches at a community level may address inequities in economic opportunities by ensuring individuals have access to employment with a living wage [43]. A study by Ray et al., in Ontario, found that the risk of assault increases with alcohol sales, particularly for urban-dwelling young males [45]. Therefore, interventions that regulate the sale of alcohol, including limitations on the hours of sale and reductions in the number of retail outlets, may represent an important avenue for the prevention of alcohol-related violence.

## Strengths and limitations

This study is strengthened by comprehensive coverage of all homicide victims in the province of Ontario, Canada, from April 2003 to December 2012, representing the largest population-based study to examine health care use among this population to date. We build on existing homicide health care use studies that were limited to single-hospital billing data by leveraging robust data linkages to capture all homicides that occurred over the study period and corresponding health care use prior to death. We aimed to descriptively characterise health care use among homicide victims [46].

This study should be interpreted in light of certain limitations. First, due to the non-specific nature of outpatient administrative billing codes, we were unable to capture outpatient care for assault. Although the majority of severe assault cases would be captured in hospital, we acknowledge that outpatient care represents a substantial source of follow-up care for patients. We were unable to capture contextual factors related to assault, including the relationship to the perpetrator, which would aid in designing and informing intervention approaches. Additionally, the data only capture physician-based services and therefore, we were unable to encompass MHA provided by allied health care professionals such as psychologists, social workers or community agencies. Further, we were unable to determine if an absence of care occurred due to lack of access or stigma or whether MHA

care was not required by the individual. We acknowledge that health care use, specifically for MHA, likely underestimates the true need for MHA among homicide victims. That said, the provincial government has recently announced it will publicly fund counselling services for all Ontarians, which may facilitate greater coverage of mental health care use in future research [47]. Lastly, to the best of our knowledge, there have been no notable changes to the way these data are collected over the study period.

## Conclusions

This population-based study of health care use among homicide victims showed that over a third of homicide victims had a MHA or assault-related health care visit prior to death. A greater proportion of females accessed care for MHA in the year before death, while a greater proportion of males accessed health care for assault-related reasons. Our findings suggest that the weeks directly after discharge for an assault visit may represent a window for the prevention of homicides. These approaches should be considered in combination with other population-based prevention approaches that address the structural and social determinants of health.

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## Statement on conflicts of interest

None declared.

## Ethics statement

This study obtained ethics approval from the Research Ethics Board at the University of Toronto (Protocol 32405). All data were deidentified and thus consent was not applicable.

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## Abbreviations

CIHI-DAD:	Canadian Institute for Health Information Discharge Abstract Database
ED:	Emergency department
ICD-10-CA:	International Classification of Disease Tenth Revision with Canadian enhancements
MHA:	Mental health and addictions
NACRS:	National Ambulatory Care Reporting System
OHIP:	Ontario Health Insurance Plan
OMHRS:	Ontario Mental Health Reporting System
ON-Marg:	Ontario Marginalization Index
ORG-D:	Ontario Registrar General's death file
RPDB:	Registered Persons Database



## Supplementary Appendices

### Supplementary Appendix 1: Mental health and addictions-related diagnostic categories

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#### Mental health and addictions-related emergency department visit (National Ambulatory Care Reporting System database)

Any MHA	ICD-10-CA: F06-F99 (excluding dementia) in primary field or X60-X84, Y10-Y19, Y28 in secondary field when there is no F06-F99 in the primary field
Substance use disorders	ICD-10-CA: F55, F10- F19
Schizophrenia	ICD-10-CA: F20 (excluding F20.4), F22, F23, F24, F25, F28, F29, F53.1
Mood and affective disorders	ICD-10-CA: F30, F31, F32, F33, F34, F38, F39, F53.0
Anxiety disorders	ICD-10-CA: F40, F41, F42, F43, F48.8, F48.9; F93.1, F93.2
Deliberate self-harm	ICD-10-CA: X60-X84, Y10-Y19, Y28 in secondary field and no identified mental health and addictions (F06-F99) in primary field

#### Mental health and addictions-related hospitalisation (Canadian Institute for Health Information's Discharge Abstract Database) as described above and the Ontario Mental Health Reporting System database

Any MHA	DSM-IV: Any (including missing diagnoses except for DSMIV 290.x. or 294.x in primary field)
Substance use disorders	DSM-IV: 291.x (0, 1, 2, 3, 5, 81, 89, 9), 292.0, 292.11, 292.12, 292.81, 292.82, 292.83, 292.84, 292.89, 292.9, 303.xx (00, 90 and 303), 304.xx (00, 10, 20, 30, 40, 50, 60, 80, 90 and 304), 305.xx (00, 10 to 90 excluding 80) or provisional diagnosis 4. Exclude if three-digit code is exactly 291/305.
Schizophrenia	DSM-IV: 295.xx (10, 20, 30, 40, 60, 70, 80, 90 and 295), 297.1, 297.3, 298.8, 298.9 or provisional diagnosis 5.
Mood and affective disorders	DSM-IV: 296.0x, 296.2x, 296.3x, 296.4x, 296.5x, 296.6x, 296.7, 296.80, 296.89, 296.90, 300.4, 301.13 or provisional diagnosis 6. Exclude if three-digit code is exactly 300.
Anxiety disorders	DSM-IV: 300.xx (00, 01, 02, 21, 22, 23, 29), 300.3, 308.3, 309.0, 309.24, 309.28, 309.3, 309.4, 309.81, 309.9 or provisional diagnoses 7, 15.

#### Mental health and addictions-related outpatient visit (Ontario Health Insurance Plan database)

Psychiatrist	Any outpatient, non-lab, OHIP visit/consult to a psychiatrist
General practitioner/family physician	Any outpatient, non-lab, OHIP visit/consult to a general practitioner/family physician with a mental health and addictions diagnostic code listed below. Mental health and addictions diagnostic codes: 295, 296, 297, 298, 300, 301, 302, 306, 309, 311, 303, 304, 897, 898, 899, 900, 901, 902, 904, 905, 906, 909, 291, 292, 299, 307, 313, 314, 315.
Paediatrician	Any outpatient, non-lab, OHIP visit/consult to a paediatrician with a mental health diagnostic code; or any OHIP visit/consult to a paediatrician in an undefined location with fee codes K122, K123, K704 and a mental health diagnostic code listed below. Mental health and addictions diagnostic codes: 295, 296, 297, 298, 300, 301, 302, 306, 309, 311, 303, 304, 897, 898, 899, 900, 901, 902, 904, 905, 906, 909, 291, 292, 299, 307, 313, 314, 315.

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Supplementary Appendix 2: Assault-related diagnostic codes

**Assault-related emergency department visit or hospitalisation (Canadian Institute for Health Information's Discharge Abstract Database or National Ambulatory Care Reporting System)**

Any assault	ICD-10-CA: X85-Y09, Y87.1
Assault by sharp or blunt object	ICD-10-CA: X99, Y00
Assault by bodily force	ICD-10-CA: Y04
Assault by firearms	ICD-10-CA: X93, X94, X9500, X9501, X9508, X9509, X96
Other assaults	All other codes not listed.

Supplementary Appendix 3: Mechanism of homicide according to underlying cause of death on the medical certificate of death from April 2003 to December 2012, by sex

	Female (n = 416)		Male (n = 1125)	
	n	%	n	%
Assault by sharp or blunt object	187	45.0	466	41.4
Assault by firearms	80	19.2	477	42.4
Assault by hanging, strangulation, and suffocation	85	20.4	20	1.8
All other assaults	64	15.4	162	14.4

Supplementary Appendix 4: Mechanism of injury for assault-related emergency department visits in the year prior to homicide, April 2003 to December 2012 (excluding visits that resulted in death)

