

Suicide and self-inflicted injury hospitalizations in Canada (1979 to 2014/15)

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Abstract

Introduction: The purpose of this paper is to describe the trends and patterns of self-inflicted injuries, available from Canadian administrative data between 1979 and 2014/15, in order to inform and improve suicide prevention efforts.

Methods: Suicide mortality and hospital separation data were retrieved from the Public Health Agency of Canada (PHAC) holdings of Statistics Canada's Canadian Vital Statistics: Death Database (CVS:D) (1979 to 2012); Canadian Socio-Economic Information Management System (CANSIM 2011, 2012); the Hospital Morbidity Database (HMDB) (1994/95 to 2010/11); and the Discharge Abstract Database (2011/12 to 2014/15). Mortality and hospitalization counts and rates were reported by sex, 5-year age groups and method.

Results: The Canadian suicide rate (males and females combined, all ages, age-sex standardized rate) has decreased from 14.4/100 000 (n = 3355) in 1979 to 10.4/100 000 (n = 3926) in 2012, with an annual percent change (APC) of -1.2% (95% CI: -1.3 to -1.0). However, this trend was not observed in both sexes: female suicide rates stabilized around 1990, while male rates continued declining over time—yet males still accounted for 75.7% of all suicides in 2012. Suffocation (hanging and strangulation) was the primary method of suicide (46.9%) among Canadians of all ages in 2012, followed by poisoning at 23.3%.

In the 2014/15 fiscal year, there were 13 438 hospitalizations in Canada (excluding Quebec) associated with self-inflicted injuries—over 3 times the number of suicides. Over time females have displayed consistently higher rates of hospitalization for self-inflicted injury than males, with 63% of the total. Poisoning was reported as the most frequent means of self-inflicted harm in the fiscal year 2014/15, at 86% of all hospitalizations.

Conclusion: Suicides and self-inflicted injuries continue to be a serious—but preventable—public health problem that requires ongoing surveillance.

Keywords: *suicide, self-inflicted injuries, intentional injuries, self-harm, suicide attempts, trends, Canada*

Introduction

Self-inflicted injury can result in hospitalization or death and is a serious public health problem in Canada, as well as internationally.^{1,2} Non-fatal self-inflicted injuries are a significant risk factor for suicide,^{3,5} making the monitoring of these outcomes critical in suicide prevention.⁶

The World Health Organization (WHO) estimated that in 2012 the age-standardized

suicide rate was 11.4/100 000 or 804 000 suicides worldwide, but acknowledges that this is likely an underestimation.² International suicide rates in 2014 were reported at 10.8/100 000 in the United Kingdom,⁷ 12.0 in Australia,⁸ and 13.0 in the United States,⁹ with varying trends over time by age, sex and method. In Canada, the most current age-standardized suicide rate (2012) was 10.4/100 000, with around 4000 deaths each year,

Highlights

- The aim of this study was to describe the trends and patterns of self-inflicted injuries, with both fatal and non-fatal outcomes, from 1979 to 2014/15, based on Canadian administrative data.
- While the Canadian suicide rate (males and females combined) has decreased slightly between 1979 and 2012, rates for females have not improved since around 1990, while male rates have continued declining.
- Suicide rates are higher among males, while hospitalizations for self-inflicted injuries are predominantly among females.

ranking it as the ninth leading cause of death by Statistics Canada.¹⁰ The accuracy of these rates is challenged by issues such as stigma and death certification validity.¹¹⁻¹⁶

Reporting on suicide attempts in Canada, as well as in other countries, is challenging and subject to underreporting. The main sources of statistical information are databases that collect self-inflicted injury hospital presentations, but these are designed for administrative rather than surveillance purposes, and do not indicate intent.¹⁷⁻²² Estimates using Canadian hospitalization data indicate that there are around 16 000 hospital separations associated with self-inflicted injuries, with a total economic burden of suicide and self-harm to Canadians estimated at \$3 billion in 2010.²³

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Prevention of self-inflicted injuries using a public health approach requires effective surveillance to define and monitor the problem, identify risk and protective factors, and ultimately support and advance effective suicide prevention efforts.⁶ There is at present no Canadian literature available which presents both mortality and hospitalization surveillance data associated with self-inflicted injuries. The objective of this study is to provide an updated, comprehensive and singularly descriptive analysis of the trends and patterns of self-inflicted injuries in Canada, with both fatal and non-fatal outcomes, by using Canadian administrative data from 1979 to 2014/15.

Methods

Suicide mortality data were retrieved from the Public Health Agency of Canada (PHAC) holdings of Statistics Canada's Canadian Vital Statistics: Death Database (CVS:D) from 1979 to 2012, and the Canadian Socio-Economic Information Management System (CANSIM) (2011, 2012), where cause of death was categorized according to WHO's *International Classification of Diseases* (ICD). The external cause of injury or poisoning was classified by each provincial Vital Statistics Registry according to the ICD, Ninth Revision (ICD-9) for deaths before 2000 (codes E950-E959) and ICD, Tenth Revision (ICD-10), for subsequent years (codes X60-X84, Y87.0). Comparability studies describing the implementation of ICD-10 in 2000 to understand the impact of the transition from ICD-9 concluded that there was no effect on the continuity of suicide data.^{24,25} Causes of death were grouped by ICD-10 chapters (1-20) for the purpose of comparing leading causes across age groups. Events associated with injury and poisoning were subdivided by intent (unintentional injury, intentionally self-inflicted injury or injury due to assault).

There is no single source for suicide attempt counts in Canada. Hospital separation data coded using ICD-10-CA* as self-inflicted injury (codes X60-X84, Y87.0) will be used as a proxy for the purposes of this study,¹⁷ and were extracted from the PHAC holdings of the Hospital Morbidity Database (HMDB) for the fiscal years (April-March) 1994/95 to 2010/11 (all provinces

and territories), and the Discharge Abstract Database (DAD) for the fiscal years 2011/12 to 2014/15 (excluding Quebec). The HMDB and DAD databases are available beginning in the fiscal year 1994/95 and are administered by the Canadian Institute for Health Information.

This study included hospital inpatient events recorded as self-inflicted in acute-care hospitals (includes both suicide attempts and self-inflicted injury without intent to die), but excluded people presenting to emergency departments (and not admitted for treatment), to psychiatric facilities or to private practice physicians, as well as those self-inflicted injury events for which treatment was not sought.

Mortality and hospitalization counts were disaggregated by sex and by 5-year age groups. The age-standardized rates were calculated using the direct method (Canada 1991).

The annual percent change (APC) in the suicide rate per 100 000 population was calculated to assess temporal trends. The APC was calculated with 95% confidence intervals separately for age, sex and method of suicide using the following equation:

$$APC = [e^{\beta} - 1] \times 100$$

where β is the slope from a regression of log rates on year.

The potential years of life lost (PYLL) were calculated specifically for suicide mortality in 2012, for males and females combined, and separately, considering premature death as occurring before age 75.^{26,27} The potential years of life lost for an age group are calculated by multiplying the number of suicides in each 5-year age group by the difference between the age group midpoint and 75.

Results

Suicide

The suicide rate in Canada (males and females combined, all ages, age- and sex-standardized rate) has decreased from 14.4/100 000 ($n = 3355$) in 1979 to 10.4/100 000 ($n = 3926$) in 2012 (APC =

-1.1%, 95% CI: -1.3 to -1.0). Despite a decreasing suicide rate, in 2012 alone, we estimate suicides accounted for 115 723 PYLL for males and females combined and separately, 89 756 years for males, and 28 967 for females. Figure 1 compares male and female suicide rates in decline since 1979, with APCs that are significant over the entire timeframe. However, it is evident from the trend line that the female suicide rate shows no further improvement after 1990, while the male rate continues dropping.

Age and sex

Figure 2 illustrates 2012 age-specific suicide rates by 5-year age group, for males and females, both combined and separately. The suicide rate peaks between 45 and 59 years of age, with the highest point at 17.4/100 000 among those aged 55 to 59 years, for both sexes combined, with the highest overall rate being 26.7/100 000 for males. Male suicide rates are substantially higher than female rates across the life course, representing 76% of all suicide cases. There are notable points among those aged 10 to 14 years where rates show no important difference between sexes. At the other extreme, rates for males over 85 years old are 6 to 10 times as high as those for females.

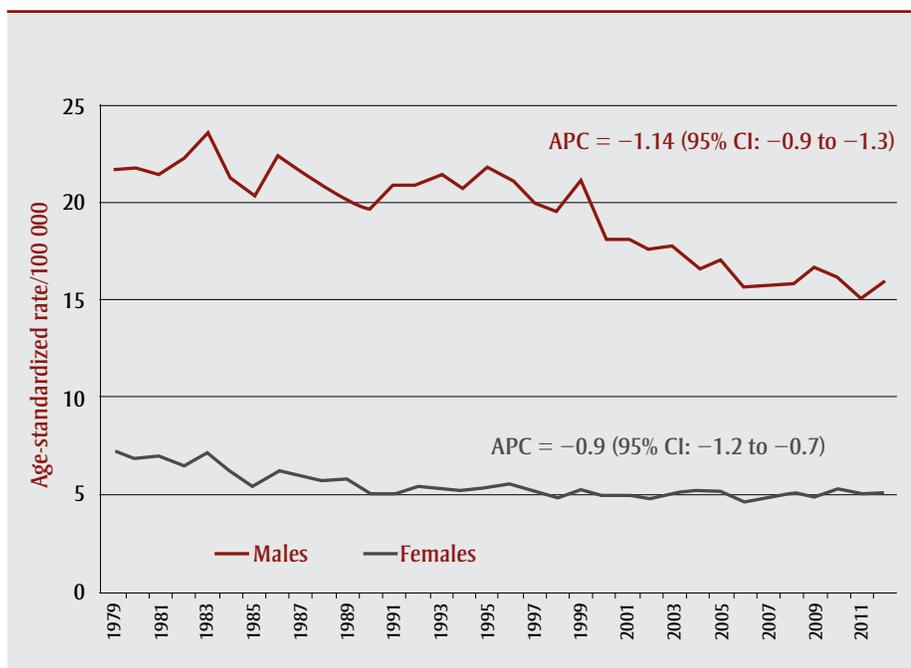
Table 1 provides leading causes of death across age groups. Suicide is the second leading cause of death for each of the 15 to 19, 20 to 24, and 25 to 34 age groups, accounting for 21.9% of all deaths between ages 15 and 34 years combined. Suicide drops to the third leading cause among those aged 35 to 44 years. The percentage of suicide-related deaths continues decreasing in rank as age increases, when compared to other important causes.

Provincial/territorial comparison

Suicide rates differ across the provinces and territories (P/Ts), as illustrated in Figure 3. Using the Canadian 1991 population's age structure for comparisons across geographic regions, Nunavut observed the highest rate of suicide (standardized rate of 63.5/100 000, $n = 24$) and Prince Edward Island observed the lowest rate (5.8/100 000, $n = 11$) (cautious interpretation advised due to low counts).

* ICD-10-CA is an enhanced version for use with morbidity classification in Canada. Beginning in 2001/02 some provinces and territories began implementing ICD-10-CA to replace ICD-9 and ICD-9-CM. By 2004/05, all provinces and territories (excluding Quebec) had completed the transition.

FIGURE 1
Age-standardized suicide rates/100 000, by year and sex, Canada 1979 to 2012



Source: Statistics Canada, Canadian Vital Statistics: Death Database (1979-2012).

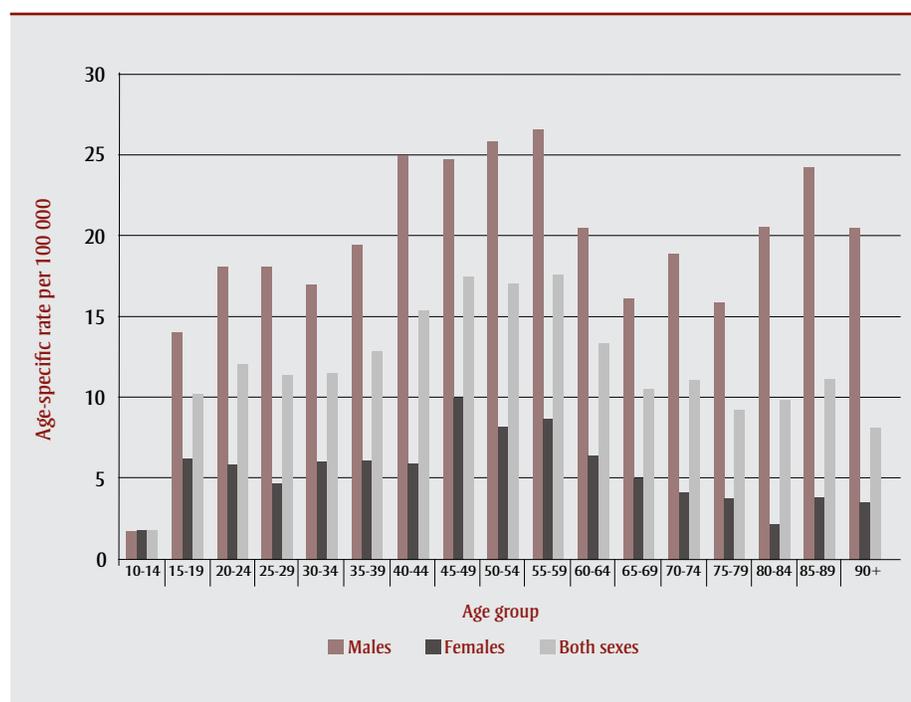
Abbreviation: APC, annual percent change.

Methods of suicide

Suffocation (asphyxiation by hanging or strangulation) accounted for nearly half of the suicides among Canadians in 2012, regardless of sex. Among males, both

poisoning and firearms ranked in equal proportion (18%) in contrast to females, where poisoning accounted for 40% and firearms only 2%. Falls and drowning were less frequent methods for both sexes (Table 2).

FIGURE 2
Age-specific suicide rates by sex and age group, Canada, 2012



Source: Statistics Canada, Canadian Vital Statistics: Death Database (2012).

Trends in hospitalizations for self-inflicted injuries

In 2014/15, there were 13 438 hospitalizations associated with self-inflicted injuries in Canada (excluding Quebec)—over 3 times the number of suicides. The age-standardized rates of hospitalizations related to self-inflicted injury in Canada (males and females combined) have been declining from 86.6/100 000 in 1994/95 to 50.2/100 000 in 2014/15; however, interpretation of trend data is not advised due to the exclusion of Quebec from 2011/12 onwards.

Age and sex

From 1994/95 to 2014/15, females have displayed consistently higher rates of hospitalizations for self-inflicted injury than males, accounting for 62% of the total as illustrated in Figure 4. Both sexes experienced a similar downward trend averaging 4% annually, between 1994/95 and 2010/11, levelling off around 2006/07.

Focussing on the most recent year of data by age group, females aged 15 to 19 years display a disproportionately high rate of hospitalizations associated with self-inflicted injuries in 2014/15 of 231.8/100 000 (n = 1897) (Figure 5), which is almost 3.5 times that of males in the same age group. Females continue to self-injure at a rate greater than males peaking again in the 45 to 49 year age range, at which point the rates decline steadily over the life course. Male hospitalizations for self-inflicted injuries are generally lower among all age groups until the 75 to 79 year age group, at which point the trend reverses for the subsequent age groups.

Provincial/territorial comparison

Figure 6 provides rates of hospitalizations associated with self-inflicted injury by province and territory. The territories combined (Yukon, Nunavut and the Northwest Territories) have the highest rate of hospitalizations associated with self-inflicted injury (155.7/100 000, n = 185) in 2014/15. Ontario has the lowest rate with 38.5/100 000 (n = 5203).

Methods of self-inflicted injury

Poisoning was reported as the most frequent means of self-inflicted injury in fiscal year 2014/15, accounting for 86% of all hospitalizations for self-inflicted injuries; of these, 66% were females (see Table 3). Hospitalizations associated with

TABLE 1
Leading causes of death in Canada, males and females combined, by age group (counts and percentages), 2012

Rank	10–14 years	15–19 years	20–24 years	25–34 years	35–44 years	45–54 years	55–64 years	≥ 65 years
1	Unintentional injuries (54, 26.6%)	Unintentional injuries (339, 41.4%)	Unintentional injuries (513, 40.5%)	Unintentional injuries (848, 30.4%)	Cancer (1242, 26.4%)	Cancer (5287, 39%)	Cancer (13 023, 47.6%)	Circulatory (57 813, 29.8%)
2	Cancer (38, 19%)	Suicide (227, 27.7%)	Suicide (291, 23.0%)	Suicide (548, 19.7%)	Unintentional injuries (857, 18.2%)	Circulatory (2526, 19%)	Circulatory (5719, 20.9%)	Cancer (55 615, 28.7%)
3	Suicide (34, 16.7%)	Cancer (62, 7.5%)	Cancer (85, 6.7%)	Cancer (400, 14.4%)	Suicide (662, 14.1%)	Unintentional injuries (1197, 9.0%)	Digestive (1484, 5.4%)	Respiratory (20 050, 10.3%)
4	Nervous system (21, 10.3%)	Nervous system (38, 4.6%)	Homicide (75, 5.9%)	Circulatory (176, 6.3%)	Circulatory (625, 13.3%)	Suicide (928, 6.9%)	Respiratory (1420, 5.2%)	Mental disorders (14 259, 7%)
5	Congenital anomalies (16, 7.9%)	Homicide (26, 3.2%)	Nervous system (62, 4.8%)	Homicide (118, 4.2%)	Digestive (214, 4.6%)	Digestive (800, 5.9%)	Endocrinal, nutritional and metabolic diseases (1121, 4.1%)	Nervous system (10 836, 5.6%)
6	Endocrinal, nutritional and metabolic diseases (7, 3.4%)	Congenital anomalies (21, 2.6%)	Circulatory (38, 3.0%)	Nervous system (88, 3.2%)	Endocrinal, nutritional and metabolic diseases (168, 3.6%)	Endocrinal, nutritional and metabolic diseases (482, 3.6%)	Unintentional injuries (1103, 4.0%)	Endocrinal, nutritional and metabolic diseases (7682, 4%)
7	Circulatory (7, 3.4%)	Circulatory (20, 2.4%)	Congenital anomalies (31, 2.4%)	Endocrinal, nutritional and metabolic diseases (66, 2.3%)	Nervous system (146, 3.1%)	Respiratory (452, 3.3%)	Nervous system (818, 3%)	Digestive (7264, 3.7%)
8	Respiratory (5, 2.5%)	Infectious (9, 21.1%)	Endocrinal, nutritional and metabolic diseases (19, 1.5%)	Digestive (59, 2.1%)	Infectious (125, 2.7%)	Nervous system (387, 2.9%)	Suicide (705, 3.0%)	Unintentional injuries (6231, 3.2%)
9	Infectious (5, 2.5%)	Blood diseases (6, 0.7%)	Infectious (15, 1.2%)	Congenital anomalies (50, 1.8%)	Respiratory (101, 2.1%)	Infectious (374, 2.8%)	Infectious (626, 2.3%)	Genitourinary (4686, 2.3%)
10	Homicide (5, 2.5%)	Respiratory (6, 0.7%)	Respiratory (10, 0.8%)	Respiratory (50, 1.8%)	Homicide (83, 1.8%)	Mental disorders (222, 1.6%)	Mental disorders (379, 1.4%)	Infectious (4538, 2.3%)
All causes ^a (244 370)	203	818	1266	2786	4702	13 494	27 364	193 737
								Suicide (531, 0.3%)
	Total suicide (3926, 1.6%)							

Source: Statistics Canada, CANSIM Tables 102-0521–102-0534, 102-0540–102-0561.

^aTotal number of deaths for persons aged 10 years and older, from all causes. Not all causes are shown here.

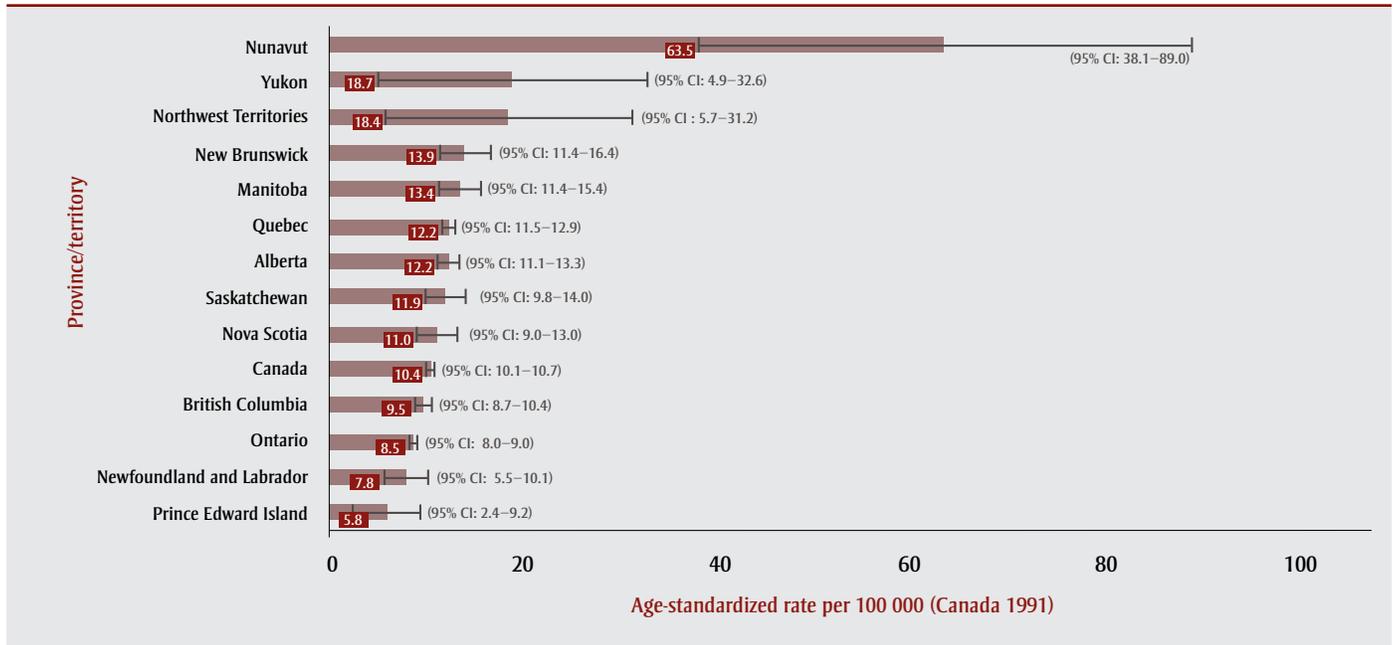
self-inflicted injury by means of cutting/piercing, suffocation and falls rank second to fourth in frequency, respectively, following poisonings. We observed no difference between males and females with regard to the ranking of methods.

Discussion

The aim of this study was to describe the trends and patterns of self-inflicted injuries, with both fatal and non-fatal outcomes from 1979 to 2014/15, based on Canadian

administrative data. The overall standardized suicide rates have been found to be decreasing over the past 33 years; however, suicide still remains a significant and extremely complex public health problem requiring ongoing surveillance to improve

FIGURE 3
Age-standardized (Canada 1991) suicide mortality rate/100 000, by province/territory, Canada, 2012



Source: Statistics Canada, Canadian Vital Statistics: Death Database (2012).

Note: The age-standardized rates were calculated to the 1991 Canadian Census population using the direct method.

understanding and guide prevention.⁶ Further examinations by sex found that male suicide rates have been declining over time, while female rates have shown no improvement during the last 10 years of the study timeframe: a trend that bears further investigation. Consistent with other studies, males generally displayed higher suicide rates than females, with the exception of earlier adolescence (10–14 years);

however, females are more frequently admitted to hospital for self-inflicted injuries (the “gender paradox” of suicidal behaviour).²⁸ Over the life course, male suicide rates were observed to steadily increase beginning in adolescence, peaking first during middle adulthood and again among seniors 80 years and older; the same pattern was also observed among females, albeit of a lesser magnitude.

Young Canadians (10–24 years) do not display the highest suicide rates overall, yet there is a noticeable peak among those aged 20 to 24 years, due primarily to suicides among males within that age group.²⁹ In contrast, when we look at the self-injury hospitalizations, there is an earlier peak, in the 15-to-19 age group, due to females. A focus on prevention specific to youth is paramount, as suicide attempts are an

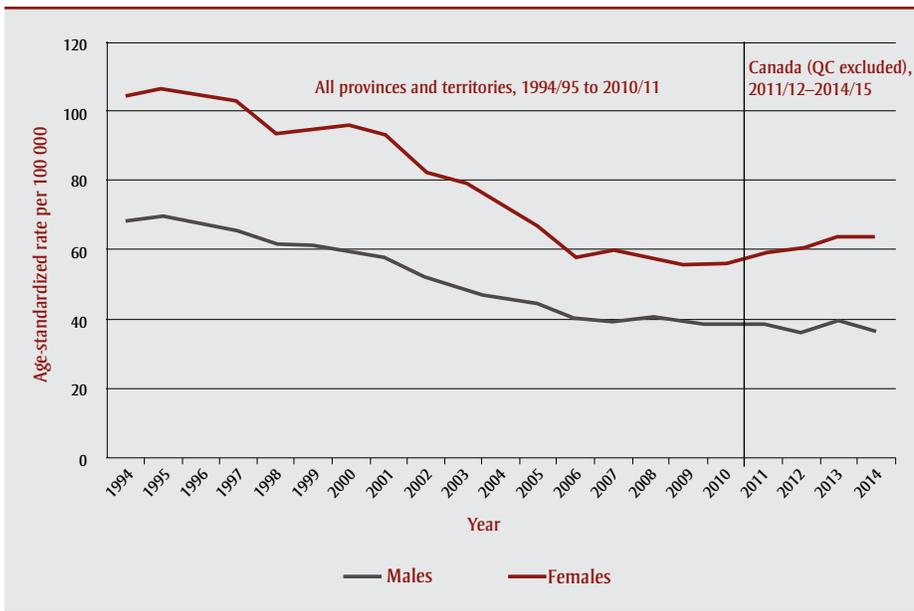
TABLE 2
Suicide in Canada by method and sex, all ages, 2012

Method	Both sexes			Males			Females		
	Cases	%	Rate/100 000 ^a	Cases	%	Rate/100 000 ^a	Cases	%	Rate/100 000 ^a
All methods	3926	100.0	11.3	2972	100.0	17.3	954	100.0	5.4
Suffocation	1843	46.9	5.3	1427	48.0	8.3	416	43.6	2.4
Poisoning	915	23.3	2.6	534	18.0	3.1	381	39.9	2.2
Firearm	544	13.9	1.6	528	17.8	3.1	16	1.7	0.1
Fall	305	7.8	0.9	229	7.7	1.3	76	8.0	0.4
Drowning	100	2.5	0.3	65	2.2	0.4	35	3.7	0.2
Cut/pierce	111	2.8	0.3	96	3.2	0.6	15	1.6	0.1
Transport	40	1.0	0.1	37	1.2	0.2	3	0.3	0.0
Fire/flame	24	0.6	0.1	18	0.6	0.1	6	0.6	0.0
Other/unspecified	44	1.1	0.1	38	1.3	0.2	6	0.6	0.0

Source: Statistics Canada, Canadian Vital Statistics: Death Database (2012).

^a Crude rate/100 000 persons.

FIGURE 4
Age-standardized hospitalization rates associated with self-inflicted injuries by year and sex, Canada 1994/95 to 2010/11 and Canada excluding Quebec 2011/12 to 2014/15



Source: Hospital Morbidity Database (2010/11), and Discharge Abstract Database (2014/15), Canadian Institute for Health Information.

the fact that attempts more often result in death among seniors, possibly due to social isolation, reduced general health, physical frailty, loneliness and depression.³³⁻³⁵ Risk for suicide among older adults is associated with suicidal ideation or behaviour, mental illness, personality vulnerability, medical illness, losses and poor social support, functional impairment and low resiliency. Among seniors, there is particular concern regarding recognition of intentional harm by self-poisoning.³³

Self-inflicted injury-related hospitalization rates, used in this study as a proxy for suicide attempts, have been declining in the last 21 years among both sexes, but remain higher among females. According to other Canadian indicators for the burden of suicide, particularly the Canadian Community Health Survey – Mental Health 2012, there were around 145 000 suicide attempts (0.5%†) by Canadians (15 years and older) in 2012, and over 900 000 Canadians (3.3%) reported experiencing “serious thoughts of committing suicide” in the past year.³⁶ This is noteworthy because suicide ideation and attempts are known to be among the greatest predictors of suicide.³⁻⁵

Consistent with other studies in Australia, England and the United States,^{20,21,37} our study found that poisoning was the most common method associated with self-inflicted injuries admitted to hospital, for both males and females. Alternately, suffocation was found to be the primary mechanism among suicides for both sexes, followed by poisoning for females, and both poisoning and firearms for males. This is comparable to earlier analysis of methods of suicide using Canadian data from 1980 to 2008, in which an increase in suffocations and a decrease in other methods (such as poisoning and firearms) was found among youth.³⁸ Monitoring of methods involved in self-injury is important in prevention of suicide by limiting access to means and as part of intervention evaluation.

Strengths and limitations

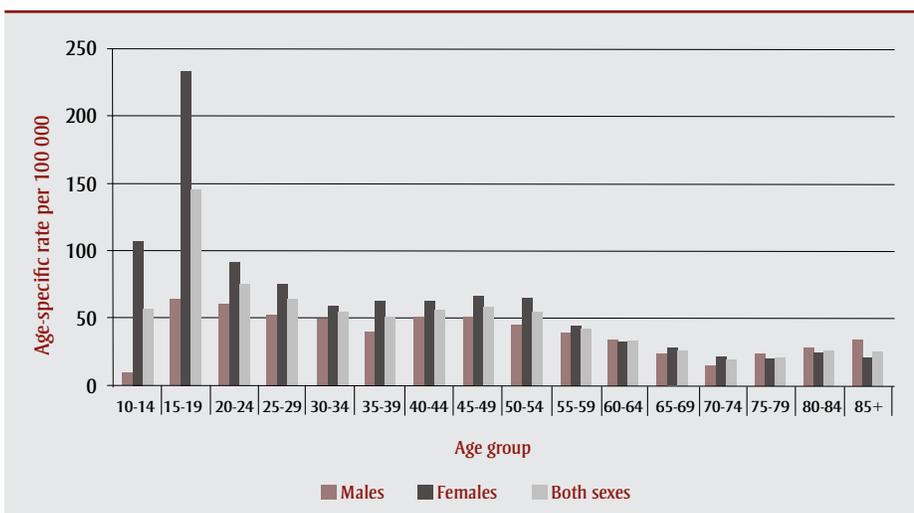
This is a retrospective observational study, which provides a comprehensive overview of trends in suicides and self-inflicted injuries resulting in hospitalizations over

important predictor of suicide,^{3-5,30-32} and youth suicides represent an early loss to society, as estimated by the PYLL. Accounting for risk-taking behaviour as a part of adolescent exploration, suicide behaviour can be the result of complex individual, family and social circumstances. For example, social disadvantage and isolation,

family social difficulties, exposure to stressful events and mental health and substance abuse problems are among some of the most difficult challenges.³⁰⁻³²

Attempted suicides are much less common among seniors when compared with younger age groups. This may be due to

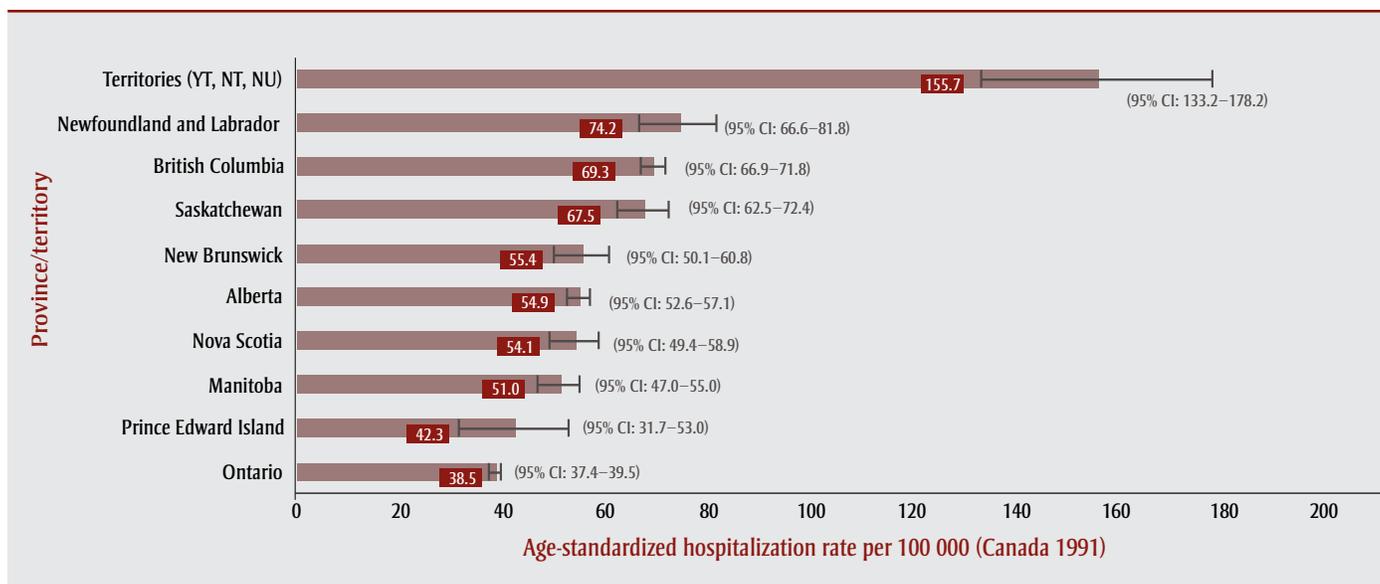
FIGURE 5
Age-specific hospitalization rates associated with self-inflicted injuries by sex and age group, age-specific rates/100 000, Canada excluding Quebec, 2014/15



Source: Discharge Abstract Database (2014/15), Canadian Institute for Health Information.

† Use with caution (these data have a coefficient of variation between 16.6% and 33.3%).

FIGURE 6
Age-standardized hospitalization rates associated with self-inflicted injuries by province/territory, Canada (excluding Quebec), 2014/15



Source: Discharge Abstract Database (2014/15), Canadian Institute for Health Information.

Abbreviations: NT, Northwest Territories; NU, Nunavut; YT, Yukon.

time. The use of administrative data restricts the number of variables for analysis and necessitates different time periods for mortality and morbidity data. The underreporting of suicides is a recognized issue in the literature,³⁹ due in part to the failure to recognize intent during the

death investigation, especially in case of poisoning, which can lead to misclassification.^{14,40,41} Due to these factors, studies have estimated suicide rates are underreported by a minimum of 10%.^{42,43} This study uses hospital separations associated with treatment of self-inflicted injuries as

a proxy for suicide attempts due to the absence of any other nationally representative indicator. Hospital morbidity statistics reflect the number of hospitalizations to acute care facilities, which may be greater than the number of individuals hospitalized, since individuals with multiple

TABLE 3
Hospitalizations associated with self-inflicted injuries by sex and method, Canada excluding Quebec, 2014/15

Method	Both sexes			Males			Females		
	Cases	%	Rate/100 000 ^a	Cases	%	Rate/100 000 ^a	Cases	%	Rate/100 000 ^a
All methods	13 438 ^b	100.0	49.2	4 987	100.0	36.9	8 448	100.0	61.3
Poisoning	11 564	86.1	42.3	3 926	78.7	29.0	7 635	90.4	55.4
Cut/pierce	1 112	8.3	4.1	588	11.8	4.3	524	6.2	3.8
Suffocation	329	2.5	1.2	204	4.1	1.5	125	1.5	0.9
Fall	161	1.2	0.6	97	2.0	0.7	64	0.8	0.5
Firearm	56	0.4	0.2	–	–	–	–	–	–
Fire/hot object/substance	42	0.3	0.2	21	0.4	0.2	21	0.2	0.2
Transport	31	0.2	0.1	22	0.4	0.2	9	0.1	0.1
Struck by/against	19	0.1	0.1	10	0.2	0.1	9	0.1	0.1
Drowning	14	0.1	0.1	9	0.2	0.1	5	0.1	0.0
Other	110	0.8	0.4	58	1.2	0.4	52	0.6	0.4

Source: Discharge Abstract Database (2014/15), Canadian Institute for Health Information.

Note: May not sum due to rounding.

– Suppressed due to cell sizes of 0 or less than 5.

^a Crude rate/100 000 persons.

^b 3 cases where sex was missing.

admissions during a single year would be counted more than once in the totals. Conversely, many individuals who attempt suicide do not necessarily receive medical treatment; therefore, many attempts may be underreported within administrative data. Furthermore, if they do present to an emergency department, they may not be admitted to hospital for care.⁴⁴ These factors together, which are also influenced by changing hospital practices, contribute to the underreporting of attempts within administrative data by as much as 50%.⁴⁵

Conclusion

Although there have been some improvements in the rates of both deaths and hospitalizations associated with self-inflicted injury, the results of the current study highlight that a serious—but preventable—public health problem remains. Ongoing surveillance of self-inflicted injury mortality and morbidity of Canadians, which involves a complex set of variables dependant on gender and stage of life, is critical to understanding the magnitude of the issue, assessing risk and protective factors and developing and evaluating effective interventions.

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