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2019 Veteran Suicide Mortality Study; Follow-up period from 1976 to 2014.

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4 December, 2019

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ISBN: 978-0-660-33879-8
Catalogue #: V3-1/5-2020E-PDF

Published by:

Veterans Affairs Canada
161 Grafton Street
Charlottetown, Prince Edward Island
C1A 8M9
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Thank you to the Health Statistics Division, Statistics Canada; and Dr. Elizabeth Rolland-Harris, DND for contributing their expertise to this study.

Citation:

Simkus K, Hall AL, Heber A, VanTil L. *2019 Veteran Suicide Mortality Study; Follow-up period 1976 to 2014*. Charlottetown (PE): Veterans Affairs Canada, Research Directorate Technical Report; 4 December, 2019.
Available at: www.publications.gc.ca

Également disponible en français: www.publications.gc.ca ISBN: 978-0-660-33880-4

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2019 Veteran Suicide Mortality Study; Follow-up period from 1976 to 2014

Executive Summary

Suicide in Canadian Veterans is a top public health concern for Veterans Affairs Canada. Collaboration between Veterans Affairs Canada, the Department of National Defence, and Statistics Canada has led to a series of reports under the Veteran Suicide Mortality Study (VSMS). In 2017, VSMS examined the magnitude of suicide risk in Canadian Veterans. In 2018, VSMS identified subpopulations within the Veteran community who were at higher risk of suicide.

In this report, the 2019 VSMS uses the military career records for over 230,000 former Canadian Armed Forces personnel linked to Canadian death records at Statistics Canada for the period 1976 to 2014. Suicides were identified by cause of death classification from provincial and territorial coroners' reports. Age-adjusted rates were calculated to examine trends over time. Standardised Mortality Ratios were calculated to compare the magnitude of suicide risk in Veterans to that of the Canadian general population.

The 2019 VSMS has three key findings:

1. Over the entire 39-year observation period, the risk of suicide for both male and female Veterans was observed to be consistently higher than in the Canadian general population. The risk observed in the additional two years of data available (2013 and 2014) was similar to previous time periods. The observed risk of suicide has neither increased nor decreased over this 39 year period.
2. Male Veterans overall had a 1.4 times higher risk of dying by suicide compared to the male Canadian general population, with the youngest group at highest risk.
3. Female Veterans overall had a 1.9 times higher risk of dying by suicide compared to the female Canadian general population, and this risk was relatively consistent across age groups.

These findings are consistent with earlier VSMS reports, as well as with similar studies from the United States, United Kingdom, and Australia. Findings from the 2019 VSMS will be used to inform suicide prevention activities for Canadian Veterans in conjunction with other research from Veterans Affairs Canada and Department of National Defence. Future VSMS reports will incorporate additional years of suicide mortality data as they become available, to continue monitoring the risk of Veteran suicide over time.

Introduction

Suicide surveillance and research is a public health priority for Veterans Affairs Canada (VAC). The monitoring and analysis of Veteran suicides, to help understand trends over time and potential risk factors, is part of the broader strategy to support ongoing suicide prevention activities.

The Veteran Suicide Mortality Study (VSMS) is a collaborative effort between VAC, the Department of National Defence (DND), and Statistics Canada. The VSMS has the following aims: to enhance the understanding of factors associated with suicide in Canadian Armed Forces Veterans, to provide updates on suicide trends over time, to inform suicide prevention activities, and to align with public expectations of timely reporting of Veteran health indicators.

Efforts to study the risk of suicide in Canadian Armed Forces Veterans have historically been challenged by limited data availability, specifically concerning the identification of Veterans in Canadian health and vital statistics databases. To address this obstacle, VAC and DND worked together to identify a large cohort of serving and released military personnel. Statistics Canada linked this information with death records obtained from Vital Statistics in all provinces and territories. The resulting data linkage was used in 2010 for the Canadian Forces Cancer and Mortality Study (Statistics Canada, 2011). In 2017, the data and epidemiological methods were improved, resulting in the Canadian Forces Cancer and Mortality Study 2 (focused on both serving and released Canadian Armed Forces members) and VSMS (focused on released members only) (Rolland-Harris, 2018a).

The 2017 VSMS found that both male and female Veterans were at higher risk of suicide compared to the Canadian general population. These elevated suicide risks remained fairly constant over the 1976 to 2012 period (Simkus 2017, VanTil 2018). The 2018 VSMS examined the characteristics of Veterans at highest risk of death by suicide, and changes in this risk by years since release (Simkus 2018).

In 2019, two more years of mortality data (2013 and 2014) became available for linkage to the Veteran cohort. The current report updates the observed trends in suicide risk over time, and by age and sex.

Methods

The 2019 VSMS follows a cohort of Veterans who released from the Canadian Armed Forces between 1976 and 2014 with service in the Regular Force and Reserve Class C (Appendix A). These individuals were identified using DND administrative pay system data. Reserve Class A and B personnel had a separate pay system, these members could not be included in the VSMS.

Several data sources were used to create the cohort. The Central Computerised Pay System records, which include information on each Veteran's occupational and deployment history, were supplemented with data from DND's Human Resources Management System to create a comprehensive military work history for personnel. Statistics Canada linked the military cohort to death records in the Canadian Vital Statistics Database, that included information on date and cause of death obtained from provincial and territorial Vital Statistics databases. Death by suicide was identified using the World Health Organisation's International Classification of Diseases (ICD) codes. Additional details on the data sources are described in Appendix B.

The complete linked dataset was anonymized and held in a secure area at Statistics Canada, where analyses were conducted by VAC and DND epidemiologists. Statistics Canada also provided aggregate data on the general Canadian population to serve as the study reference population. The study follow-up period was 39 years, since the earliest date that Veterans could be identified in the cohort was 1976, and mortality data were available up to 2014 at the time of data linkage. Additional details on the linkage are reported elsewhere (Rolland-Harris, 2018a).

The age and sex distributions of the Veteran cohort and the Canadian general population (CGP) are quite different. For this reason, separate analyses were performed for males and females. For each of these groups, two different types of analyses were conducted to estimate the risk of suicide and death in the Veteran population while accounting for age differences: standardised mortality ratios (SMR) and age-adjusted rates. Age group categories were typically divided into 5-year intervals, except when collapsed as required to maintain confidentiality.

SMRs were calculated by age group to compare the risk of suicide in Veterans to the CGP. A value of 1.0 indicates that the risk of death in the Veteran group is the same as the CGP. 95% Confidence Intervals (CIs) were also calculated to illustrate the amount of random error in the estimates; Confidence Intervals that overlap 1.0 indicate that the SMR is not statistically significant from the CGP.

Age-adjusted suicide rates were calculated for both Veterans and the CGP. The rates were adjusted using the age distribution of the 1991 Canadian population.

Several findings in this report are based on calculations using small numbers, contributing to wide confidence intervals. In compliance with Statistics Canada privacy regulations, all SMRs and rates were collapsed and presented in age or time period categories that ensured minimum cell counts of 10. Where collapsing was not possible, data points were suppressed (indicated by *). This includes instances where the number of new deaths occurring since release of the 2017 VSMS were fewer than 10. Updated release dates (usually due to re-enlistment in the cohort) and improvements in processing led to the revision of some counts compared to those previously published.

Additional details on the analyses are described in Appendix C.

Results

Cohort Summary

The final linked VSMS cohort included 231,733 Canadian Veterans by the end of the study period in 2014 (Appendix A). The Veteran cohort was 89% male, with 60% of all cohort members released at a Junior Non-Commissioned Member (NCM) rank, and 29% released since 2000. Some cohort members had a combination of service experience in both the Regular Force and as Class C Reservists during their careers. The majority of the cohort (95%) had belonged to the Regular Force at some point in their military careers; 15% had belonged to the Class C Reserve at some point. Table 1 provides additional details on this cohort's military characteristics.

Table 1. Military characteristics of the 1976-2014 VSMS cohort.

	Male		Female	
	N	%	N	%
Total in cohort	206,765	89.2%	24,968	10.8%
Still alive Dec 31, 2014	183,490	88.7%	-*	-*
Died during study period	23,275	11.3%	-*	-*
Rank at release				
Junior NCM	122,166	59.1%	17,038	68.2%
Senior NCM	46,904	22.7%	2,795	11.2%
Officer	37,515	18.1%	5,123	20.5%
Missing	180	0.1%	12	0.0%
Total	206,765	100.0%	24,968	100.0%
Component				
Regular Force only	176,626	85.4%	19,726	79.0%
Both Reg and Res C Force	20,173	9.8%	3,163	12.7%
Reserve C Force only	9,966	4.8%	2,079	8.3%
Total	206,765	100.0%	24,968	100.0%
Era of first enrolment				
Pre-1976	73,062	35.3%	3,231	12.9%
1976-1987	85,560	41.4%	13,251	53.1%
1988-1999	27,913	13.5%	5,266	21.1%
2000-2014	20,230	9.8%	3,220	12.9%
Total	206,765	100.0%	24,968	100.0%
Era of release				
1976-1987	87,518	42.3%	8,578	34.4%
1988-1999	60,444	29.2%	7,477	29.9%
2000-2014	58,803	28.4%	8,913	35.7%
Total	206,765	100.0%	24,968	100.0%

* Suppressed, due to small magnitude of change since the 2017 report

Male Suicide Mortality Over Time

Veteran males overall had a 1.4 times higher risk of suicide death than the Canadian General Population, when adjusted for age differences. This risk was higher than the Canadian General Population in all time periods examined, and did not change significantly across time periods. The suicide risk of male Veterans was lowest during the two most recent years for which data were available (2013 to 2014), however this was not significantly different from previous time periods (Table 2 and Figure 1).

Table 2. Comparison of male Veteran and Canadian suicide risks using Standardised Mortality Ratios (SMR) by time period, 1976 to 2014.

Time period [†]	N	Suicide SMR (95% CI)
1976-1982	94	1.33 (1.07 – 1.62)
1983-1987	154	1.44 (1.23 – 1.69)
1988-1992	217	1.59 (1.39 – 1.82)
1993-1997	260	1.52 (1.34 – 1.71)
1998-2002	244	1.35 (1.19 – 1.53)
2003-2007	221	1.23 (1.08 – 1.41)
2008-2012	265	1.34 (1.19 – 1.51)
2013-2014	107	1.21 (1.00 – 1.47)
Total	1,562	1.39 (1.32 – 1.46)

[†] 5 year period, except first period of 7 years to avoid suppression, and last period of 2 years available since the 2017 report.

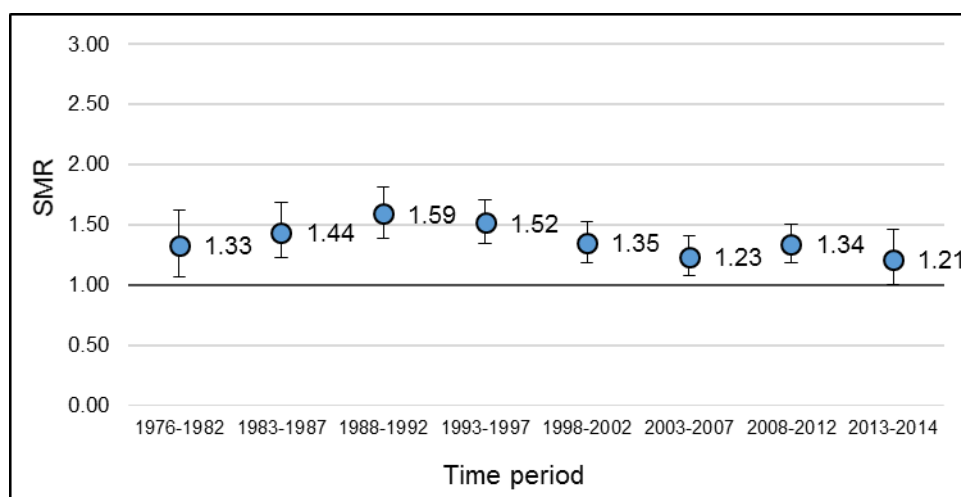


Figure 1. Comparison of male Veteran and Canadian suicide risks using Standardised Mortality Ratios (SMR) by time period, 1976 to 2014.

Male Suicide Mortality by Age Group

Although Veteran males overall had a 1.4 times higher risk of suicide death than the Canadian General Population, the risk was highest in the youngest age group, and decreased with age (age analysis described in Appendix C). Males under 25 years of age had a 2.5 times higher risk compared to males of the same age in the Canadian General Population. In contrast, male Veterans aged 55 to 64 years had a 36% lower risk of suicide compared to the CGP, and those aged 65 years and older had a 52% lower risk (Table 3 and Figure 2).

Table 3. Comparison of male Veteran and Canadian suicide risks using Standardised Mortality Ratios (SMR) by age group, 1976 to 2014.

Age group	N	Suicide SMR (95% CI)
Under 25	180	2.52 (2.18 – 2.92)
25 to 34	399	1.87 (1.69 – 2.06)
35 to 44	447	1.65 (1.50 – 1.81)
45 to 54	366	1.20 (1.08 – 1.33)
55 to 64	122	0.74 (0.62 – 0.89)
65 and over	48	0.48 (0.36 – 0.64)
Total	1,562	1.39 (1.32 – 1.46)

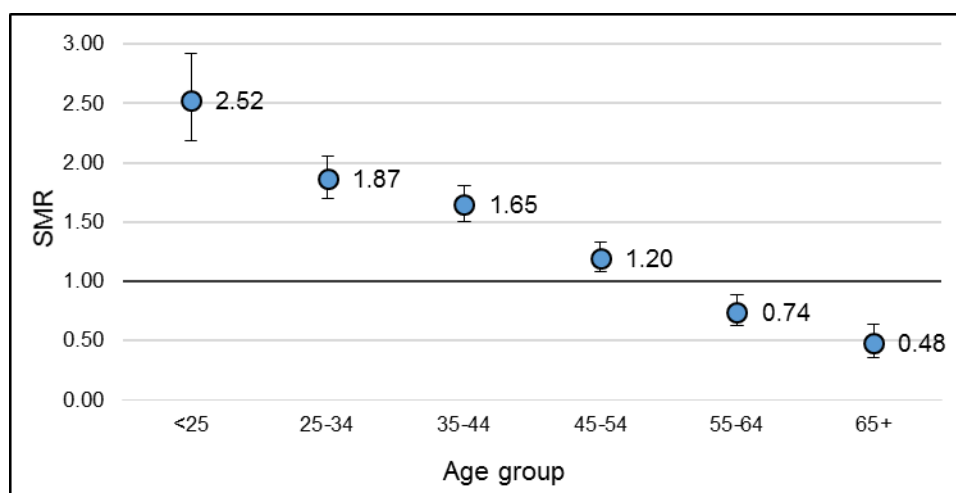


Figure 2. Comparison of male Veteran and Canadian suicide risks using Standardised Mortality Ratios (SMR) by age group, 1976 to 2014.

Female Suicide Mortality Over Time

Female Veterans overall had a 1.9 times higher risk of suicide death than the Canadian General Population, when adjusted for age differences. This risk did not change significantly across time periods (Table 4 and Figure 3).

Table 4. Comparison of female Veteran and Canadian suicide risks using Standardised Mortality Ratios (SMR) by time period, 1976 to 2014.

Time period	N	Suicide SMR (95% CI)
1976-1990	-*	1.90 (0.98 – 3.33)
1991-1998	-*	1.46 (0.73 – 2.61)
1999-2006	-*	2.19 (1.39 – 2.54)
2007-2014	-*	1.71 (1.37 – 2.54)
Total	-*	1.88 (1.47 – 2.38)

* Suppressed, due to small magnitude of change since the 2017 report

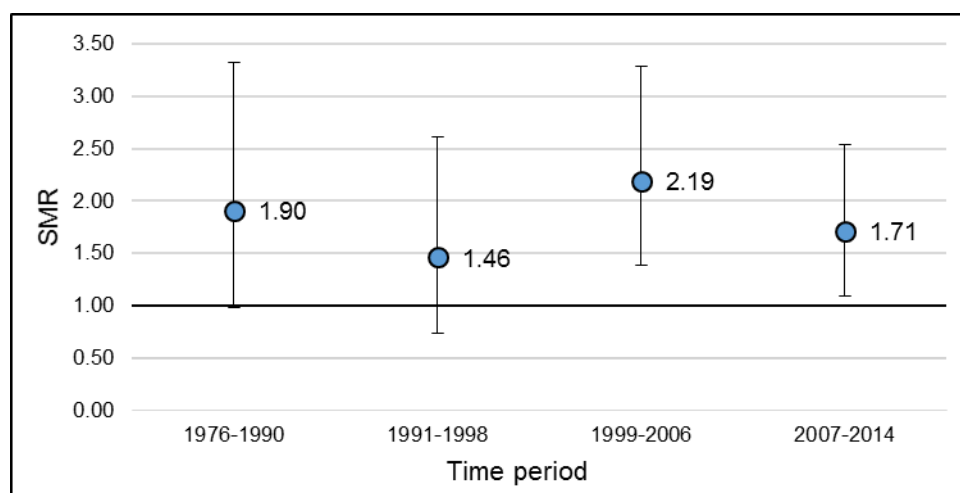


Figure 3. Comparison of female Veteran and Canadian suicide risks using Standardised Mortality Ratios (SMR) by time period, 1976 to 2014.

Female Suicide Mortality by Age Group

Overall, female Veterans had an 1.9 times higher risk of dying by suicide compared to the female Canadian General Population, and the risk was consistently elevated in all three age groups. The small number of female suicides overall restricted the analysis to three age groups (Table 5 and Figure 4).

Table 5. Comparison of female Veteran and Canadian suicide risks using Standardised Mortality Ratios (SMR) by age group, 1976 to 2014.

Age Group	N	Suicide SMR (95% CI)
16 to 34	-*	2.17 (1.34 – 3.31)
35 to 49	-*	1.66 (1.14 – 2.33)
50+	-*	2.12 (1.21 – 3.44)
Total	-*	1.88 (1.47 – 2.38)

* Suppressed, due to small magnitude of change since the 2017 report

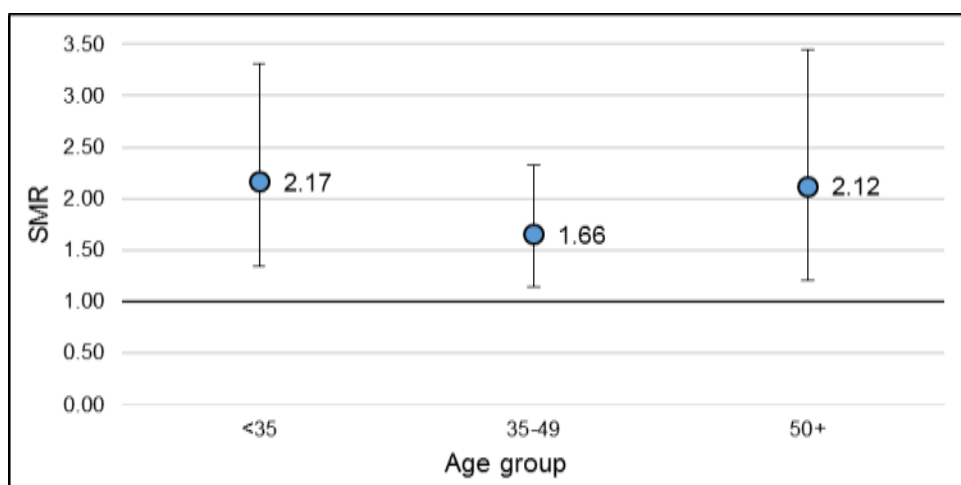


Figure 4. Comparison of female Veteran and Canadian suicide risks using Standardised Mortality Ratios (SMR) by age group, 1976 to 2014.

Comparison of Male and Female Suicide Mortality

Overall, age-adjusted suicide rates per 100,000 person-years for male and female Veterans were higher than in the Canadian General Population. The Veteran male suicide rate was 3.8 times higher than that of Veteran females (Figure 5).

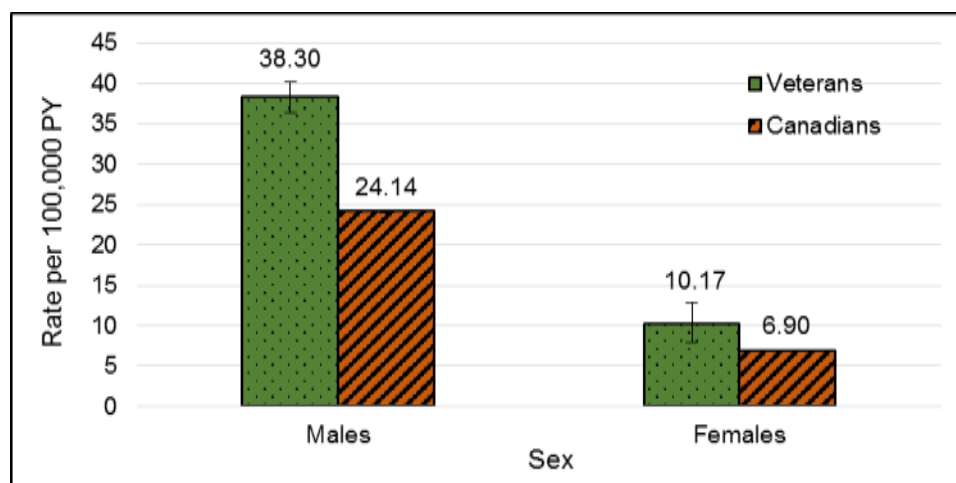


Figure 5. Age-adjusted suicide rates for Veterans and Canadians, 1976 to 2014; rates standardized to the 1991 Canadian age distribution.

Discussion

Suicide is a critical public health concern for VAC. With assistance from DND and Statistics Canada, VAC has conducted analyses of the largest available dataset with cause of death and military service information for Canadian Armed Forces Veterans. The 2019 Veteran Suicide Mortality Study's key findings are as follows:

1. Over the entire 39-year observation period, the risk of suicide for both male and female Veterans was observed to be consistently higher than in the Canadian general population. The risk observed in the additional two years of data available (2013 and 2014) was similar to previous time periods. The observed risk of suicide has neither increased nor decreased over this 39 year period.
2. Male Veterans overall had a 1.4 times higher risk of dying by suicide compared to the male Canadian general population, with the youngest group at highest risk.
3. Female Veterans overall had a 1.9 times higher risk of dying by suicide compared to the female Canadian general population, and this risk was relatively consistent across age groups.

The standardised mortality ratios presented in this report indicate that Veterans have an increased risk of suicide compared to the Canadian General Population. Overall, the age-adjusted suicide rate for male Veterans was 38 per 100,000 person-years; this was 1.4 times higher risk of death by suicide compared to the Canadian General Population. For female Veterans, the age-adjusted suicide rate was 10 per 100,000 person-years; this was 1.9 times higher risk of suicide death compared to the female Canadian General Population. Similar to what has been observed in the general population (Health Canada, 1994; Navaneelan, 2016), the Veteran Suicide Mortality Study found that male Veterans had a 3.8 times higher rate of suicide than female Veterans. The risk of suicide overall for male and female Veterans in Canada has remained stable over the 39 year study period, including the most recent period of 2013 and 2014. These findings are consistent with earlier findings (Simkus 2017).

For male Veterans, the risk of suicide was highest in the youngest group of Veterans: those aged less than 25 years had 2.5 times higher risk of suicide compared to the male Canadian General Population. A statistically significant higher risk of suicide persisted until 54 years of age. The higher risk in young male Veterans is consistent with earlier findings of highest suicide risk approximately 4 years after release (Simkus 2018).

For female Veterans, the risk of suicide did not change with age. The risk was consistently elevated in all age groups, compared to the Canadian General Population.

The longstanding increased risk of suicide for Veterans (both male and female) compared to the Canadian general population underscores the importance of the Canadian Armed Forces and Veterans Affairs Canada Joint Suicide Prevention Strategy (CAF-VAC 2017). The differing patterns of suicide risk by age for males and females suggest that risk factors may differ between the sexes. Prevention and treatment efforts should take sex differences into account, while avoiding a sole focus on only males or females.

Studies of Veteran suicide in other countries have observed similar findings to the VSMS, especially concerning risk in younger males (Australian Institute of Health and Welfare, 2017; Kapur 2009). In a study of US Veterans, male Veterans were 1.5 times and female Veterans 5.9 times more likely to die by suicide than expected (Hoffmire, 2015). However, the stable Veteran suicide rates in Canada stand in contrast to US findings that describe increasing rates over the period of 2001 to 2014 (USDVA 2017).

Strengths and Limitations

One of the key strengths of this study is the comprehensiveness of its data sources. The use of pay data ensures that all persons that had military pay were included in the cohort, and the use of official death records ensures that Veterans' suicide deaths are equally likely to be reported as suicide deaths in the Canadian General Population. The large cohort numbers and lengthy follow-up period provide the best available picture of the risk of death by suicide for both male and female Canadian Veterans.

However, these data sources do not characterize the full military career of Veterans, nor their experiences following release from the military. The findings from VSMS should therefore be considered in conjunction with other forms of research that examines suicidality (ideation, attempts and suicide death).

Conclusions

Suicide among Canadian Veterans continues to be a top public health concern. Collaborative efforts by Veterans Affairs Canada, The Department of National Defence, and Statistics Canada have resulted in the successful linkage of military career records of over 230,000 Veterans to Canadian death records over a 39-year time period. Both male and female Canadian Veterans have a significantly higher risk of death by suicide compared to Canadians in the general population. At particular risk are the youngest male Veterans. Findings from the current study can be used to inform suicide prevention activities for Canadian Veterans.

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Appendix A – Cohort Definition

The VSMS follows Canadian Veterans who released from the Canadian Armed Forces between January 1, 1976 and December 31, 2014, with service in the Regular Force and/or Reserve Class C. The cohort was defined using pay data from DND's Central Computerised Pay System and death records from Statistics Canada's Canadian Vital Statistics Database under the following inclusion criteria:

- a) cohort members must have released from the Canadian Armed Forces on or after 1976;
- b) cohort members must no longer be serving as of December 31, 2014, and must be surviving upon their release (i.e. did not die in service); and
- c) cohort members' age at enrolment/release and dates of death must be logical relative to their service time.

The cohort grew from 9,885 Veterans in 1976 to 231,733 Veterans by the end of 2014 (Figure A). This includes Veterans who died during this period, although Veterans were removed from the study population upon their death in order to accurately calculate suicide SMRs and rates.

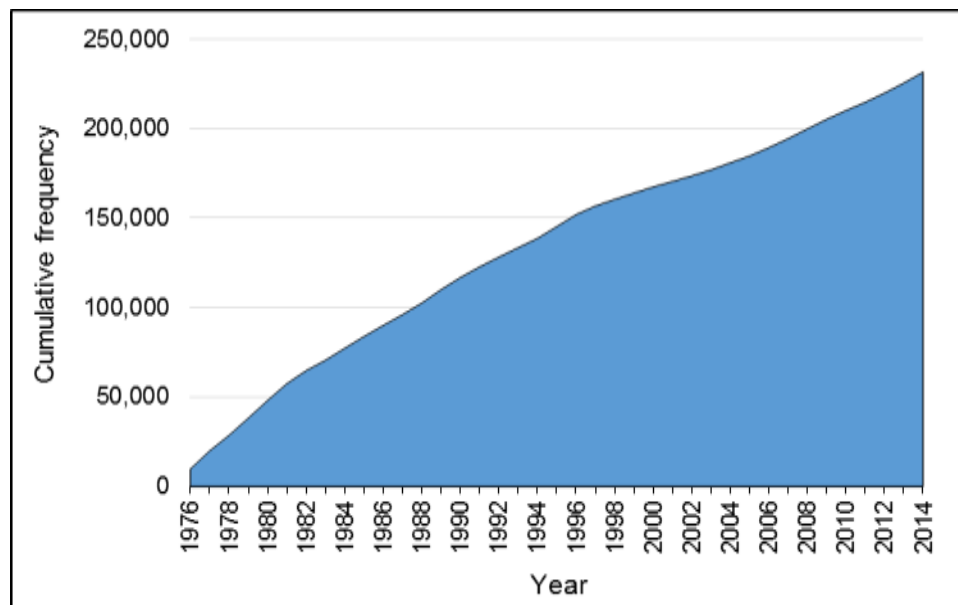


Figure A. Cumulative frequency of new Veterans entering the VSMS cohort, 1976 to 2014.

Because Reserve "A" and "B" personnel are paid through a different system, these Veterans were not included in this study.

The data were reviewed and cleaned; where corrections could not be made, exclusion criteria were applied. For example, 16 years was set as the minimum age at enrolment and release, and 60 years was set as the maximum age at enrolment. Any personnel with a death record who had died 14 days or fewer after release were assigned as "in-service deaths" instead of Veteran deaths due to the greater possibility of the release date being entered incorrectly; this decision was supported by data from previous DND studies that showed alignment between the number of suicides within 14 days of release with the known number of in-service suicide deaths. "In-service deaths" also included "deceased" as reason for release.

Appendix B – Data Sources

The **Central Computerised Pay System** is an electronic DND dataset that identifies all Regular Force and Class C Reservists (those Reservists who participated in international operations and/or tours of duty) who enrolled into and/or released from the Canadian Armed Forces dating back to 1976. The Central Computerised Pay System has an accuracy and precision advantage from its built-in feedback mechanism, whereby both personnel and the employer are motivated to correct pay errors as soon as possible. Salaries and pay amounts were not shared with the research team; only end dates of pay were used to identify when each service member ended their employment with the Canadian Armed Forces (“released”).

This cohort file was supplemented and validated using data from The **Human Resources Management System**. The Human Resources Management System is an additional DND administrative dataset that contains demographic and occupational information on serving Canadian Armed Forces personnel. The incorporation of this second data source served to reduce the amount of missing information, and to resolve inaccuracies in reporting.

The **Canadian Vital Statistics Database**, composed of Vital Statistics Registry data from each province and territory, provides mortality information from 1950 to the most recent year available. The mortality variables used in the VSMS are date of death and its underlying cause, as indicated by the International Classification of Diseases (ICD) code assigned at the time of death. The codes for suicide deaths changed over the study period:

- 1976 to 1978: ICD 8 codes E950-E959
- 1979 to 1999: ICD-9 codes E950-E959
- 2002 to 2014: ICD-10 codes X60-X84 and Y87.0

The International Classification of Diseases case definition for suicide death is consistent with that used by DND (Rolland-Harris, 2016) and Statistics Canada (Navaneelan, 2016).

The cohort file was deterministically linked by Statistics Canada to the Canadian Vital Statistics Database using identifiers consistent to both datasets (primarily Social Insurance Number). The anonymized linked data were held in a secure area within Statistics Canada and were accessible only to designated researchers at DND and VAC. Further details on the data and linkage methodology is published under the Canadian Forces Cancer and Mortality Study 2 protocol, which uses the same source of linked data as the VSMS (Rolland-Harris, 2018a).

Aggregate Canadian population data and death data were provided by Statistics Canada in the form of historical reports and CANSIM tables available publicly online¹. Population counts and death counts were available by sex, 5-year age groups, year, and ICD codes for cause of death.

¹ Statistics Canada. Table 13-10-0156-01 Deaths, by cause, Chapter XX: External causes of morbidity and mortality (V01 to Y89) DOI: <https://doi.org/10.25318/1310015601-eng>

Appendix C – Data Analysis

Privacy Regulations

In compliance with the requirements of the *Statistics Act*, all death counts fewer than 10 must be suppressed. Therefore, where required, age groups or time periods were collapsed to ensure death counts were greater than or equal to 10. Where it was not possible to collapse subgroups, counts or rates were suppressed.

Cohort Description

A summary was prepared to describe the age and sex distribution of the Veteran cohort by sex, age at study end, age at death, component, rank, era of enrolment, and era of release.

Standardised Mortality Ratios

Standardised Mortality Ratios (SMR) were used to compare rates of suicide within the VSMS cohort to those of the CGP. Suicide rates were calculated separately for males and females, for each time period of follow-up, and for each age group in the VSMS cohort. These were compared with the corresponding group in the general population using indirect standardisation methods.

A SMR value of 1.0 indicates that the observed mortality in the Veteran cohort was the same as that observed in the CGP. Values less than 1.0 suggest lower than expected mortality in the Veteran cohort, while values greater than 1.0 suggest higher than expected mortality in the Veteran cohort. In addition to the point estimate, 95% confidence intervals (CIs) were calculated to illustrate the amount of random error in the estimates, which is particularly valuable when dealing with small numbers of cases. The calculation of confidence intervals used either normal approximation (death counts ≥ 100) or the exact Poisson method (death counts < 100). SMR confidence intervals that overlap 1.0 are not statistically significant. See Figure B for a visual example of interpreting SMRs and their confidence intervals.

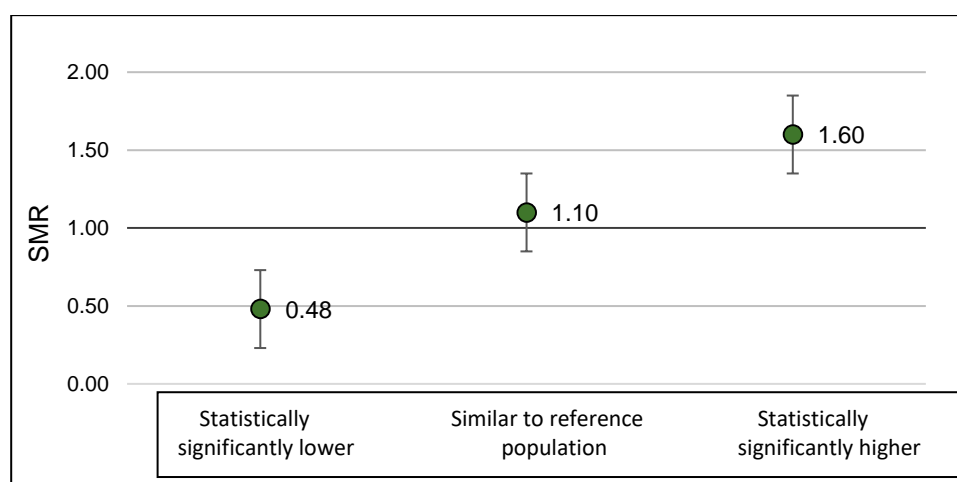


Figure B. Example on how to interpret standardised mortality ratios (SMR) and their corresponding confidence intervals (CIs).

Standardized mortality ratios provide comparisons to the Canadian General Population, and are often used in mortality studies. They are used to estimate the excess risk of death in a population of interest; this information can be applied to target public health interventions and resources.

Age-adjusted rates

Age-adjusted suicide and all-cause mortality rates for both Veterans and the Canadian General Population were calculated to examine temporal trends, using direct standardisation with the current population standard (1991 CGP) for Canadians aged 15 and older as a reference.

In addition to overall age-adjusted rates presented for the 1976 to 2014 study period, annual age-adjusted rates are presented in this report. However, small numbers of deaths (the numerator) and/or small populations (the denominators) can lead to statistically unstable rates. Age categories were assigned using date of death for numerators and (alive) age for each year of the study for denominators. For rates, 95% confidence intervals were calculated using either normal approximation (death counts ≥ 100) or the exact Poisson method (deaths counts < 100). Linear trends were generated and used to estimate temporal suicide trends for both Veterans and the Canadian General Population.

Software

All data cleaning, manipulation, and analyses were conducted using Stata 14 and Microsoft Excel. Data linkages were conducted using SAS 9.3.