

Canadian Armed Forces Suicide Risk and Protection over 16 Years

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Abstract

Introduction: Canadian Armed Forces (CAF) soldiers and veterans face a higher suicide risk than the general population. However, differences between correlates of types of suicide expression, namely suicidal ideation (SI), suicide plans (SP) and suicide attempts (SA), have not been established. This study aimed to identify risk and protective factors for new-onset suicide behaviours among CAF members and veterans.

Methods: Data from the 2018 Canadian Armed Forces Members and Veterans Mental Health Follow-up Survey (CAFVMHS) (n=2941), including participants from the 2002 Canadian Community Health Survey on Mental Health and Wellbeing: Canadian Forces Supplement (CCHS-CFS) (n=2458 reported no suicide behaviour). Descriptive analyses assessed the prevalence of risk and protective factors, and logistic regression analyses evaluated the odds of suicide outcomes. Population attributable fractions (PAFs) assessed the population-level impact.

Results: Suicide risk factors included mental disorders, deployment-related experiences and trauma, chronic pain and physical health conditions, and self-medicative avoidant coping. Protective factors included problem-solving, increased perceived life satisfaction and social support.

Discussion: This study identifies the high-risk groups for suicide behaviours in the CAF's active duty and veterans and highlights where preventative measures may be useful in reducing the onset of suicide behaviours.

Introduction

Suicide behaviour is a significant public health concern among military service members, with an increased number of suicide attempts among military personnel compared to the general population in Canada.¹ Suicidal ideation (SI), suicide plans (SP), and suicide attempts (SA) are the strongest risk factors for death by suicide.² Data from nationally representative Statistics Canada surveys on Canadian Armed Forces (CAF) personnel have shown a significant increase in SI and SA from 2002 to 2012.¹

It is important to understand specific factors that are associated with the onset of different suicide behaviours (i.e., SI, SP and SA). In comparison with the general population of Canada, CAF members have been shown to have a higher prevalence of depression, anxiety and alcohol-use disorders.³ Furthermore, CAF military members who died by suicide were more likely to have depression, bipolar disorder and alcohol-related problems.⁴ In a follow-up study with US Air Force members, suicide risk was found to be associated with mental health diagnoses, including mood disorders, substance-use disorders (SUD) and anxiety disorders.⁴ Among military members, post-traumatic stress disorder

(PTSD) was similarly associated with higher rates of SI and SA.⁵ Studies of UK and Australian army members found that suicide rates were highest among males of lower rank.^{6,7}

Traumatic experiences also appear to influence the development of suicide behaviour in CAF members, with the highest prevalence of SI and SA associated with childhood maltreatment, assaultive violence and peacekeeping traumas.⁵ Traumatic experiences relating to war are an increasingly common factor for heightened suicide behaviour among military personnel, with a greater likelihood of suicide behaviours in CAF members who experienced active military combat, peacekeeping and relief work and being a prisoner of war.⁵ A higher prevalence of suicide behaviour has also been reported among survivors of military sexual trauma compared to members who have not faced military sexual trauma;⁸ specifically, SI and SP were higher among military members who experienced sexual trauma during service in both men and women, while SA increased in men.

There is evidence that physical health is associated with SI among CAF members.^{9,10} Higher prevalence of SI was found in CAF veterans who experienced chronic pain or physical health conditions after military service.⁹ One study found that veterans

diagnosed with at least one mental health diagnosis and three or more physical conditions had a higher likelihood of experiencing SI.⁹ Similarly, military personnel with traumatic brain injury (TBI) were found to be at a higher prevalence for major depression and SI.¹⁰

Prior research has focused heavily on correlates of suicide behaviour. However, few have investigated the wide range of risk and protective factors associated with new onset of SI, SP and SA in military personnel. Moreover, most research has focused on the investigation of a limited scope of mental disorders, traumatic exposures and other risk and protective factors. Few studies have incorporated a range of predictors, particularly in the context of the Canadian military. To address these gaps, this study aimed to examine longitudinal risk and protective factors of new-onset suicide behaviour among current and former active-duty CAF members.

Methods

Participants

Data for this study were obtained from a nationally-representative sample of active-duty service members and veterans who had originally participated in the 2002 Canadian Community Health Survey on Mental Health and Wellbeing: Canadian Forces Supplement (CCHS-CFS) and were re-interviewed 16 years later as part of the 2018 Canadian Armed Forces Members and Veterans Mental Health Follow-up Survey (CAFVMHS). The CCHS-CFS (2002) sample consisted of 5155 active-duty personnel aged 15 to 64 years. Sixty-eight per cent (n=2941) of eligible participants from the CCHS-CFS responded to the follow-up timepoint in 2018 (CAFVMHS).¹¹

Measures

Suicide behaviours. All CAFVMHS participants were asked about their lifetime history of suicide behaviour (i.e., SI and SA) at baseline in 2002. Participants were asked in the CAFVMHS if they had ever: a) seriously thought about attempting suicide or taking their own life; b) made a plan for attempting suicide; and/or c) attempted suicide or tried to take their own life. Of the full sample, 2458 participants reported no prior history of suicide behaviour in 2002, which formed the sample population for this study. Those with a prior history of suicidal behaviour in 2002 were removed.

New-onset suicide behaviour was assessed in 2018 with identical questions, wherein respondents were asked if they had experienced SI, SP or SA between 2002 and 2018 (since the last interview). Individuals

who reported multiple types of suicide behaviour were assigned to the more severe suicide behaviour group (SA > SP > SI), such that the groups were mutually exclusive.

Demographic and military characteristics.

Sociodemographic variables were assessed as current in 2018, including sex (female or male), income (\$0-89 999 or \$90 000+), marital status (partnered or not partnered), education level (post-secondary degree or equivalent, or less than post-secondary degree) and age. Additional military-related demographic variables assessed included member status (active-duty or veteran), rank (junior non-commissioned officer, senior non-commissioned officer, and officers) and military environmental command (land, air, sea).

Mental disorders. Using the World Health Organization Composite International Diagnostic Interview (WHO-CIDI) version 3.0,^{12,13} mental disorder diagnoses of major depressive disorder (MDD), general anxiety disorder (GAD), PTSD, panic disorder (PD), social phobia (SOP) and alcohol-use disorder (AUD) were assessed according to criteria from the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition (DSM-IV).¹⁴ In this study, mental health disorder diagnoses were assessed as having onset between baseline (2002) and follow-up (2018).

Deployments. A single yes/no question asked whether the individual had been deployed between 2002 and 2018.

Traumatic experiences. In 2018, respondents were asked about their exposure to 26 types of traumatic events that occurred between 2002 and 2018 as part of the WHO-CIDI PTSD module.¹³ Based on prior work,¹⁵ traumatic events were grouped into summary categories including deployment-related trauma (4 items; e.g., peacekeeping, combat exposure), accidental trauma or other unexpected events (10 items; e.g., life-threatening accident, toxic chemical exposure), sexual trauma (2 items; e.g., unwanted touching, sexual assault), interpersonal trauma (5 items; e.g., spousal abuse, being mugged), civilian in war or refugee trauma (3 items; e.g., civilian in war zone, refugee, civilian in religious terror), an event that occurred to someone close (1 item; 'Has anyone very close to you ever had an extremely traumatic experience, like being kidnapped, tortured or sexually assaulted?'), or any other life-threatening event (1 item, 'any other event not listed above').

Work stress. Work stress was assessed in 2018 using the Job Content Questionnaire.¹⁶ The Job Content Questionnaire is a 12-item measure used to assess

six dimensions of work stress (decision authority/control, job security, psychological demand, physical exertion, social support from colleagues/supervisors, and skill discretion/demand), and is measured using a 5-point Likert scale (strongly agree to strongly disagree). These items were summed and assessed using a continuous total work stress scale ranging from 0 to 40. In 2018, work stress questions were restricted to participants who were currently employed or on active duty at the time of the interview. A mean split was used to convert continuous variables into dichotomous categories. Participants with scores below the sample mean were categorised as having 'low' levels of work stress, while those with scores above the mean were categorised as having 'high' levels.

Physical health conditions. In 2018, respondents were asked about current chronic physical health conditions, specifying whether they had been diagnosed with any of the 19 conditions (yes/no). Physical health conditions included cancer, TBI, migraine, inflammatory bowel disease, irritable bowel syndrome, intestinal or stomach ulcers, chronic fatigue, diabetes, stroke, heart disease, high blood pressure, high cholesterol, back problems, arthritis, chronic bronchitis/emphysema/COPD, asthma, multiple sclerosis, liver disease and epilepsy. Of these, arthritis, migraines, back problems and gastrointestinal conditions (i.e., inflammatory bowel disease, irritable bowel syndrome and intestinal or stomach ulcers) were grouped into a single 'any chronic pain condition' variable to capture conditions associated with chronic pain based on previous research.¹⁷ All 13 remaining physical health conditions were grouped into an 'any other physical health condition' group, and a count of the number of physical health conditions was also created (0–13). A mean split was used to transform the continuous variable into a dichotomous measure. Participants with scores below the sample mean were classified as having a 'low' number of physical health conditions. In contrast, those with scores above the mean were classified as having a 'high' number of physical health conditions.

Self-perceived health and life satisfaction. Self-perceived health describes the respondent's health status based on their own judgement. This measure captured the individual's self-rated physical and mental health, each rated on a 5-point Likert scale (poor to excellent) with higher scores indicating lower perceived health status. Participants were also asked to rate their life satisfaction on a 5-point Likert scale (very satisfied to very dissatisfied), with higher scores reflecting greater dissatisfaction with life. Additionally, a mean split was used to create

dichotomous variables categorising values as 'high' or 'low' based on whether they fell above or below the sample mean.

Coping mechanisms. Participants were asked about their use of different coping strategies derived from the Coping Inventory to Problems Experienced (COPE) Scale, the Ways of Coping Questionnaire, and the Coping Strategy Indicator.¹⁸ The scale comprised 14 questions, each rated on a 4-point Likert scale ('I haven't been doing this' to 'I've been doing this a lot'). Prior factor analysis indicated a three-factor solution: 1) problem-solving coping style (4 items); 2) self-medication coping style (2 items); and 3) avoidance coping style (5 items). Higher scores in each category reflect more use of that coping style (i.e., a higher problem-solving coping style score reflects greater use of problem-solving coping). Continuous variables were dichotomised using a mean split, yielding 'high' and 'low' groups based on the sample mean for each coping mechanism.

Social Support. Participants' level of social support was measured in 2018 using the Medical Outcomes Study (MOS) Social Support Survey,¹⁹ which included 11 items covering emotional support and/or informational support and affection. These items were summed to yield a total score ranging from 0–55, with higher scores indicating greater perceived social support. A mean split was applied to create dichotomous variables, dividing participants into 'high' and 'low' groups relative to the sample mean.

Statistical Analysis

Statistical analyses were conducted using STATA version 16.²⁰ To ensure the representativeness of the sample to the CAF in 2002 and to account for missing data and the complex sampling design, sampling and bootstrapping weights created by Statistics Canada were used. Cross tabulations examined the prevalence of each risk or protective factor by suicide behaviour type (i.e., SI, SP and SA). Logistic regression analyses measured the associations between the risk and protective factors and each suicide behaviour outcome. Population attributable fractions (PAFs) were calculated to estimate the proportion of each outcome among CAF personnel that could be attributed to exposure to specific protective and risk factors, indicating the percentage of cases that might not have occurred in the absence of those factors.^{21–23} PAFs were only run for variables with significant adjusted odds ratios (AORs).

Results

Of the 2458 individuals without suicide behaviour at baseline, a total of 351 CAF veterans and active-

duty members met criteria for new-onset suicide behaviour in the 16-year follow-up period; 9.4% of the sample reported new-onset SI, 4.2% reported new-onset SP, and 2.6% reported new-onset SA. Table 1 outlines the demographic characteristics of the 2018 sample of 351 CAF veterans and activity duty members who met the criteria for new-onset suicide behaviour. Detailed demographic variables for the 2018 sample have been previously reported.²⁴ 72% of the members who met the criteria for new-onset suicide behaviours had transitioned into veteran status since the 2002 questionnaire. Table 2 shows sociodemographic and military demographic characteristics. Among those with new-onset suicide behaviour, the mean age was 49.8 years old. Female (vs male), higher income level (vs lower), senior non-commissioned member (NCM) or officer rank (vs junior NCM), and older age were associated with significantly decreased odds of SI, SP and SA. Individuals who had released from service by 2018 were at statistically higher risk for suicide behaviour compared to those who remained in active duty, as were those with an unpartnered marital status (vs partnered).

Table 3 shows the onset of suicide behaviours in relation to the presence of mental disorders between 2002 and 2018. Experiencing a new onset of MDD, GAD, PTSD, PD and SOP since 2002 was associated with an increased likelihood of new-onset suicide behaviours. PTSD had the highest prevalence of new-onset suicide behaviours, wherein 51.9% of those who met criteria for PTSD in the follow-up period experienced new-onset SI, 29.2% experienced new-onset SP, and 13.2% experienced new-onset SA. Individuals with a mental disorder diagnosis had a 6- to 20-fold increased likelihood of new-onset SI, SP and SA. These associations were attenuated but remained significant after adjustment for sociodemographic and military demographic characteristics. MDD (PAFs: 74.6–77.9%) and PTSD (PAFs: 54.3–74.8%) had the highest PAFs for all suicide behaviours.

The relationships between deployment, traumatic experiences and work stress with new-onset suicide behaviour are displayed in Table 4. Having been deployed between 2002 and 2018 was strongly associated with increased odds of new-onset SI and SP (AORs: 2.25–3.49; PAFs: 51.7–68.1%). Experiencing a deployment-related trauma, accidental trauma or other unexpected event, interpersonal trauma, traumatic experience of someone very close, or other life-threatening traumas was associated with higher odds of new-onset suicide behaviour and increased PAFs.

Table 1. Veterans and active duty members that met criteria for new onset suicide behaviour in the 16-year follow-up period.

	2018 new onset suicide behaviour cohort (n=351)	
	%	95% CI
Sex		
Male	84.7 ^a	82.3-86.6
Female	15.3	13.3-17.6
Member Status		
Active	28.4	23.9-33.3
Veteran	71.7	66.7-76.1
Income		
\$0-89 999	34.6	30.1-39.4
\$90 000+	65.4	60.6-69.9
Rank		
Junior NCM	35.7	30.9-40.9
Senior NCM	46.0	40.9-52.3
Officer	18.2	15.3-21.6
Marital Status		
Partnered	79.1	74.9-82.8
Not partnered	20.9	17.3-25.1
Education Level		
Post-secondary degree or equivalent	44.5	39.4-49.7
Less than post-secondary degree	55.5	50.3-60.6
Current or last military environmental command		
Land	48.2	43.1-53.2
Air	32.6	28.0-37.5
Sea	19.3	15.6-23.6
Age		
33-50	45.0	40.1-50.0
51-56	34.1	29.5-39.1
57 years+	20.9	17.4-24.9

CI = confidence interval. NCM = Non-commissioned officer. ^aPercentage indicates that 84.7% of the participants that reported no suicide behaviour in 2002, reported suicide behaviour in 2018.

Table 2. Association between sociodemographic characteristics, military demographics and new-onset suicide behaviour between 2002–2018.

	New-onset ideation		New-onset plans		New-onset attempts	
	%	OR (95% CI)	%	OR (95% CI)	%	OR (95% CI)
Sex						
Male	16.9 ^a	1.00	7.1	1.00	2.9	1.00
Female	14.5	0.83 (0.64–1.09)	3.8	0.51** (0.32–0.82)	0.8	0.27** (0.10–0.72)
Member status						
Active	11.2	1.00	3.3	1.00	1.4	1.00
Veteran	19.6	1.93*** (1.44–2.59)	8.6	2.78*** (1.62–4.76)	3.4	2.48** (1.00–6.13)
Income						
\$0–89 999	23.0	1.00	10.9	1.00	4.7	1.00
\$90 000+	14.2	0.55*** (0.42–0.73)	5.0	0.43*** (0.29–0.64)	1.9	0.40** (0.21–0.78)
Rank						
Junior NCM	26.7	1.00	11.4	1.00	5.4	1.00
Senior NCM	16.7	0.55*** (0.41–0.74)	6.9	0.57** (0.37–0.87)	2.3	0.40** (0.20–0.79)
Officer	7.3	0.22*** (0.15–0.31)	2.2	0.17*** (0.10–0.31)	0.9	0.16*** (0.06–0.42)
Marital status						
Partnered	15.7	1.00	5.8	1.00	2.1	1.00
Not partnered	20.9	1.42* (1.02–1.98)	11.0	2.02** (1.25–3.25)	5.8	2.90** (1.44–5.85)
Education level						
Post-secondary degree or equivalent	19.8	1.00	7.9	1.00	3.6	1.00
Less than post-secondary degree	14.2	0.67*** (0.53–0.86)	5.7	0.71 (0.48–1.04)	2.0	0.55 (0.29–1.03)
Current or last military environmental command						
Land	22.5	1.00	9.0	1.00	- ^b	-
Air	9.9	0.38*** (0.28–0.51)	3.6	0.38*** (0.24–0.60)	-	-
Sea	14.3	0.57** (0.41–0.81)	6.7	0.73 (0.43–1.24)	-	-
Mean age						
Age	49.8 ^d	0.97*** (0.96–0.99)	49.4	0.97** (0.94–0.99)	47.9	0.94** (0.91–0.98)

* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq 0.001$. OR = unadjusted odds ratio; CI = confidence interval. NCM = Non-commissioned officer. ^aPercentage indicates that 16.9% of males reported SI in 2018. ^bCells removed due to a small number of respondents. ^dAge was mean centered (49.8 years),

Table 3. Association between mental health diagnoses and new-onset suicide behaviour between 2002–2018.

	New-onset ideation			New-onset plans			New-onset attempts		
	%	AOR (95% CI)	PAF (95% CI)	%	AOR (95% CI)	PAF (95% CI)	%	AOR (95% CI)	PAF (95% CI)
MDD									
No	6.0 ^a	1.00	-	1.5	1.00	-	^b	-	-
Yes	43.8	11.46*** (8.26–15.89)	74.6 (67.1–80.7)	20.0	13.56*** (7.30–25.18)	77.9 (63.9–87.2)	-	-	-
GAD									
No	9.2	1.00	-	2.9	1.00	-	0.8	1.00	-
Yes	46.1	7.69*** (5.66–10.46)	50.6 (41.7–59.2)	22.3	8.35*** (5.05–13.79)	53.0 (38.3–66.2)	10.3	11.03*** (4.74–25.74)	60.6 (36.4–79.1)
PTSD									
No	9.8	1.00	-	2.4	1.00	-	0.6	1.00	-
Yes	51.9	8.76*** (6.31–12.16)	54.3 (44.9–63.1)	29.2	15.71*** (9.41–26.23)	69.3 (56.3–79.4)	13.2	20.33*** (8.10–51.02)	74.8 (52.1–88.5)
PD									
No	10.7	1.00	-	3.6	1.00	-	1.2	1.00	-
Yes	51.0	6.90*** (4.91–9.69)	46.0 (36.1–55.6)	25.6	6.83*** (4.40–10.58)	45.7 (32.9–58.0)	10.8	6.37*** (3.05–13.30)	43.7 (22.8–64.0)
SOP									
No	9.4	1.00	-	2.8	1.00	-	0.9	1.00	-
Yes	49.1	6.90*** (4.91–9.69)	51.3 (41.1–60.8)	24.9	6.83*** (4.40–10.58)	51.0 (37.8–63.1)	11.0	6.37*** (3.05–13.30)	48.9 (26.8–68.7)
AUD									
No	12.5	1.00	-	4.1	1.00	-	1.7	1.00	-
Yes	38.7	3.65*** (2.67–4.99)	29.3 (20.7–38.4)	20.7	4.66*** (3.00–7.23)	36.4 (23.8–49.3)	8.0	3.30*** (1.63–6.66)	26.4 (9.0–46.9)

* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq 0.001$. OR = unadjusted odds ratio; CI = confidence interval; AOR = adjusted odds ratio adjusted for socio-demographic variables: sex, member status, income, rank, marital status, education, environmental command, and age. MDD = Major depressive disorder. GAD = Generalized anxiety disorder. PTSD = Post-traumatic stress disorder. PD = Panic disorder. SOP = Social phobia disorder. AUD = Alcohol use disorder. ^aPercentage indicates that 6.0% of those who did not meet criteria for MDD reported SI in 2018. ^bCells removed due to a small number of respondents.

Table 4. Association between military and traumatic experiences, work stress and new-onset suicide behaviour between 2002–2018.

	New-onset ideation			New-onset plans			New-onset attempts		
	%	AOR (95% CI)	PAF (95% CI)	%	AOR (95% CI)	PAF (95% CI)	%	AOR (95% CI)	PAF (95% CI)
Ever deployed									
No	9.3 ^a	1.00	-	2.4	1.00	-	1.2	1.00	-
Yes	18.1	2.25*** (1.53–3.30)	51.7 (31.2–66.3)	7.6	3.49** (1.45–8.39)	68.1 (27.8–86.30)	2.9	2.40 (0.57–10.14)	-
Deployment-related trauma									
No	12.4	1.00	-	4.3	1.00	-	1.9	1.00	-
Yes	22.1	1.86*** (1.39–2.49)	26.8 (14.3–38.8)	9.9	2.21*** (1.44–3.40)	34.0 (15.8–50.6)	3.7	1.38 (0.69–2.74)	-
Accidental trauma or other unexpected events									
No	9.0	1.00	-	2.6	1.00	-	1.1	1.00	-
Yes	20.1	2.46*** (1.76–3.44)	50.0 (34.2–62.5)	8.7	3.14*** (1.78–5.52)	59.4 (34.8–75.5)	3.5	2.45 (0.95–6.31)	-
Sexual trauma									
No	16.3	1.00	-	6.5	1.00	-	^b	-	-
Yes	22.8	1.61 (0.83–3.12)	-	10.1	1.89 (0.66–5.35)	^c	-	-	-
Interpersonal trauma									
No	11.6	1.00	-	4.5	1.00	-	-	-	-
Yes	27.6	2.57*** (1.75–3.76)	19.1 (10.1–29.4)	14.2	2.88*** (1.63–5.09)	22.1 (8.7–38.1)	-	-	-
Civilian trauma									
No	16.2	1.00	-	6.3	1.00	-	-	-	-
Yes	23.0	1.33 (0.78–2.25)	-	14.0	2.04 (0.98–4.24)	-	-	-	-
Traumatic experience of someone very close									
No	15.2	1.00	-	6.0	1.00	-	-	-	-
Yes	34.5	2.94*** (1.93–4.48)	11.8 (6.0–19.4)	16.1	2.95*** (1.54–5.67)	11.9 (3.6–24.4)	-	-	-
Other life threatening events trauma									
No	14.8	1.00	-	5.8	1.00	-	2.2	1.00	-
Yes	39.4	2.90*** (1.82–4.63)	10.3 (4.7–18.0)	19.2	2.71** (1.42–5.19)	9.4 (2.5–20.3)	8.4	2.28 (0.90–5.74)	-

* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq 0.001$. OR = unadjusted odds ratio; CI = confidence interval; AOR = adjusted odds ratio adjusted for socio-demographic variables: sex, member status, income, rank, marital status, education, environmental command, and age. ^aPercentage indicates that 9.3% of those who were not deployed between 2002 and 2018 reported SI in 2018. ^bCells removed due to a small number of respondents. ^cPAF not run because AOR was not significant.

Table 5. Association between current physical health conditions and new-onset suicide behaviour between 2002–2018.

	New-onset ideation			New-onset plans			New-onset attempts		
	%	AOR (95% CI)	PAF (95% CI)	%	AOR (95% CI)	PAF (95% CI)	%	AOR (95% CI)	PAF (95% CI)
Chronic pain conditions									
No	9.6 ^a	1.00	-	3.0	1.00	-	1.4	1.00	-
Yes	21.5	2.39*** (1.75–3.26)	45.2 (30.8–57.2)	9.3	3.04*** (1.80–5.15)	54.7 (32.1–71.1)	3.5	2.45* (1.02–5.88)	46.2 (1.2–74.3)
Physical health conditions									
No	11.9	1.00	-	4.9	1.00	-	1.9	1.00	-
Yes	21.7	2.34*** (1.74–3.13)	50.1 (35.7–61.5)	8.7	1.99** (1.26–3.14)	42.6 (16.3–61.6)	3.5	2.22* (1.07–4.60)	47.8 (5.0–73.0)
Number of physical conditions									
Low	12.5	1.00	-	5.1	1.00	-	2.3	1.00	-
High	27.2	2.69 (2.00–3.63)***	31.5 (21.4–41.8)	10.6	2.10 (1.32–3.35)**	23.1 (8.0–39.1)	3.5	1.60 (0.80–3.16)	-
Perceived general health									
Low	25.7	1.00	-	11.2	1.00	-	^b	-	-
High	6.4	0.24 (0.17–0.34)***	-66.6 (-77.5)–(-53.2))	1.7	0.17 (0.10–0.36)***	-77.5 (-89.9)–(-50.7))	-	-	-
Perceived mental health									
Low	49.6	1.00	-	25.5	1.00	-	10.3	1.00	-
High	8.7	0.12 (0.09–0.16)***	-20.6 (-21.4)–(-19.5))	2.2	0.08 (0.06–0.13)***	-21.7 (-22.6)–(-20.3))	0.1	0.10 (0.04–0.22)***	-21.1 (-22.9)–(-17.8))

* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq 0.001$. OR = unadjusted odds ratio; CI = confidence interval; AOR = adjusted odds ratio adjusted for socio-demographic variables: sex, member status, income, rank, marital status, education, environmental command, and age. ^aPercentage indicates that 9.6% of those who did not endorse a current chronic pain condition reported SI in 2018. ^bCells removed due to a small number of respondents.

Table 5 examines the relationship between respondents' physical health conditions and new-onset suicide behaviour between 2002 and 2018. Experiencing at least one chronic pain condition and/or physical health condition was strongly associated with higher odds of SI, SP and SA, even after adjusting for sociodemographic and military demographic characteristics. Additionally, a higher average number of physical health conditions was associated with increased odds of new-onset SI and SP. Higher perceived general health were associated with decreased odds of SI (AOR: 0.24; PAF: -56.3%) and SP (AOR: 0.17; PAF: -64.9%), and higher perceived mental health were associated with decreased SI (AOR: 0.12; PAF: -244.1%), SP (AOR: 0.08; PAF: -287.0%) and SA (AOR: 0.10; PAF: -264.3%).

Table 6 provides a summary of the relationship between psychosocial factors and self-perceived health with the new onset of suicide behaviour. Lower use of problem-solving coping and higher use of avoidant and self-medicative coping styles were associated with a higher odds of new-onset SI, SP and SA. Higher self-perceived life satisfaction and higher reported levels of social support were associated with significantly lower odds and PAFs for new-onset SI, SP and SA.

Discussion

In this study, veterans had higher odds of experiencing new-onset SI, SP and SA compared to active-duty members. New onset of suicide behaviour in the 16-year follow-up was less likely among respondents

Table 6. Association between psychosocial factors and self-perceived health and new onset suicide behaviour between 2002–2018.

	New-onset ideation			New-onset plans			New-onset attempts		
	%	AOR (95% CI)	PAF (95% CI)	%	AOR (95% CI)	PAF (95% CI)	%	AOR (95% CI)	PAF (95% CI)
Coping Styles									
Problem solving									
Low	33.2 ^a	1.00	-	16.8	1.00	-	7.2	1.00	-
High	11.5	0.32 (0.24–0.42)***	-19.0 (-21.8)–(-15.8)	3.7	0.24 (0.16–0.38)***	-21.8 (-24.6)–(-17.1)	1.3	0.22 (0.11–0.43)***	-22.5 (-26.5)–(-15.5)
Self medicating									
Low	13.1	1.00	-	4.5	1.00	-	1.5	1.00	-
High	40.0	3.27 (2.39–4.46)***	23.7 (16.0–32.2)	20.3	3.82 (2.42–6.02)***	27.9 (16.3–40.8)	9.5	4.06 (1.94–8.50)***	29.6 (11.4–50.7)
Avoidant									
Low	10.8	1.00	-	4.1	1.00	-	1.6	1.00	-
High	41.1	5.20 (3.85–7.02)***	44.1 (34.9–53.1)	18.0	4.10 (2.62–6.37)***	36.8 (23.3–50.2)	7.4	3.61 (1.83–7.11)***	32.9 (13.5–53.5)
Life Satisfaction									
Low	45.6	1.00	-	22.2	1.00	-	9.2	1.00	-
High	10.6	0.17 (0.13–0.23)***	-16.6 (-17.5)–(-15.2)	3.5	0.17 (0.11–0.28)***	-16.6 (-17.5)–(-15.2)	1.3	0.20 (0.09–0.44)***	-15.9 (-18.5)–(-10.6)
Social support									
Low	28.5	1.00	-	12.8	1.00	-	4.8	1.00	-
High	12.4	0.34 (0.26–0.46)***	-21.2 (-24.4)–(-16.7)	4.5	0.35 (0.22–0.54)***	-20.8 (-26.0)–(-13.9)	1.9	0.47 (0.24–0.92)*	-16.3 (-25.2)–(-2.2)
Work stress									
Low	10.0	1.00	-	3.2	1.00	-	^b	-	-
High	17.0	1.61 (1.13–2.30)**	95.5 (81.9–97.8)	5.0	1.25 (0.66–2.35)	^c	-	-	-

* $p \leq 0.05$. ** $p \leq 0.01$. *** $p \leq 0.001$. OR = unadjusted odds ratio; CI = confidence interval; AOR = adjusted odds ratio adjusted for socio-demographic variables: sex, member status, income, rank, marital status, education, environmental command, and age. ^aPercentage indicates that 33.2% of those who endorsed low problem-solving coping reported SI in 2018. ^bCells removed due to a small number of respondents. ^cPAF not run because AOR was not significant.

with higher income, higher military rank and those who were partnered. A previous study reported that higher educational levels were linked to increased suicide prevalence,²⁵ which aligns with our finding that greater educational achievement is associated with significantly higher odds of new-onset SI. Between 2012 and 2021, 130 male CAF active-duty members died from suicide, compared to 13 female CAF active-duty members who died by suicide in the same time frame.²⁶ While the frequency of suicide deaths can be attributed to there being more male CAF members (16% of active-duty members in the CAFs were female),²⁷ females were found to be at a significantly decreased risk for all suicide behaviours. Additionally, consistent with prior research,²⁶ suicide prevalence was higher in CAF members who were separated and at a lower military rank. Junior

NCMs had significantly higher odds of experiencing new-onset SI, SP and SA than senior NCMs. In accordance with NATO Standardization Agreement (STANAG) 2116, Senior NCM officers are classified under NATO codes OR-7 to OR-9.²⁸ A previous study found that a history of deployment was not significantly associated with suicide behaviour; however, we found higher frequencies of new-onset SI, SP and SA in those who had experienced at least one deployment between 2002 and 2018.²⁹

The higher odds of new-onset SI, SP and SA observed among veterans compared to active-duty members may reflect several interconnected factors. The transition from military to civilian life after service may reflect changes in income, social support, work-related stress and overall life satisfaction. Veterans

are also more likely to be older in age compared to active-duty members, so that they may have greater exposure to traumatic behaviours, chronic pain and physical health conditions. All these factors have been associated with suicide behaviour. Although our study does not determine the risk of new-onset suicide behaviour in the transition from active-duty to veteran status, prior research suggests that suicide risk may increase years after military service.³⁰ Lower prevalence of suicide behaviours in active-duty members may be that they are less likely to report active suicide behaviours due to concerns about stigma and hindrance to their career advancement.³¹

The presence of a mental health diagnosis (i.e., MDD, GAD, PTSD, PD, SOP) was associated with a higher odds of new-onset SI, SP and SA. PAFs for PTSD were 54.3–74.8%, meaning more than half to three-quarters of the new-onset suicide behaviours in the population can be attributed to PTSD. A diagnosis of PTSD represented the strongest association for all suicide behaviours, with the highest magnitude of association among those with SA. These findings are similar to a study on military members in the US, which found that veteran status and a PTSD diagnosis significantly strengthened the correlation of SI and SAs.³² Lifetime history of AUD is common in military veterans and has been linked with increased rates of SI.³³ In the current study, we found increased prevalence of new onset of all types of suicide behaviours among those with AUD.

Most traumatic experiences were associated with increased odds of new-onset suicide behaviours, with interpersonal traumatic experiences having the highest significant odds of new-onset SI and SP, with PAFs of 19.1% and 21.1%, respectively. Experiencing any traumatic experience between 2002 and 2018 was associated with all new-onset suicide behaviours. Similarly, Kimerling et al. found a significant association between military sexual trauma and suicide risk in male and female veterans.³⁴

Our study found that chronic pain and physical health conditions had a significant association with all forms of new suicide behaviours, in line with previous findings.⁹ A higher sense of general health, mental health and overall life satisfaction was strongly associated with significantly lower odds of SI, SP and SA. Previous research has shown that veterans who died by suicide were more likely to have increased physical health problems compared to nonveterans who died by suicide.³⁵ Few studies have examined protective factors against SI, SP and SA in veterans. We found that problem-solving coping was associated with significantly lower odds of all new-

onset suicide behaviours, which is consistent with previous research.³⁶ Alternatively, self-medication and avoidant coping styles had the opposite effect. Protective factors, such as problem-solving coping mechanisms, may be useful for suicide prevention strategies. Previous research demonstrated that cognitive behavioural therapy was effective in reducing suicide behaviours.³⁷ Similarly, group brief cognitive behavioural therapy was effective in increasing coping skills and suicide prevention in military members.³⁸

Despite these important findings, the current study has several limitations that need to be considered. First, mental health disorder diagnoses followed WHO-CIDI guidelines for assessment of mental disorders by trained lay interviewers and may not reflect clinician-based diagnoses. Second, sample size issues may have limited this work. For example, analyses on SA were removed for military environmental command, MDD, sexual trauma and civilian trauma due to sample size constraints. As such, some of our findings may not have been sufficiently powered to detect differences between groups. Third, while we examined SI, SP and SA, the data regarding death by suicide were not gathered in the CAFVMHS, and other datasets would need to be used to examine suicide deaths. Fourth, this study only includes data on active-duty members and veterans, thereby limiting generalisability to reservists. Finally, our examination of new-onset suicide behaviours was limited to a 16-year follow-up. A timeline for the development of suicidality and correlates of suicide behaviour (e.g., onset of mental disorders, onset of physical health conditions) for participants was not available, so causality cannot be assumed.

These findings have several implications that could be useful for improving targeted suicide prevention and related efforts to reduce new onset of suicide behaviour in active-duty and veteran soldiers. In addition to targeting CAF members and veterans who screen positive for SI, SP and SA, suicide prevention initiatives should prioritise individuals who screen positive for mental health disorders, traumatic experiences, chronic pain and other physical health conditions, as these factors were associated with increased risk for all types of suicide behaviour. Targeted supports should focus on protective factors, such as increased problem-solving coping and social support. Increased support for veterans after service, such as transition programs, may be beneficial. This research identifies key risk and protective factors for active-duty and veteran members of the CAF, and these findings have implications for targeted suicide prevention strategies for active-duty military

members and veterans. Consideration in future studies may include examining the new onset of suicide behaviours in the transition from active-duty to veteran status, identification of additional protective factors and assessment of prevention programs.

Declarations

Authors' Note: Data are available through Statistics Canada Research Data Centres. Statistics Canada collected and supplied the data for academic use. However, analyses and interpretations presented are solely those of the authors and do not reflect the views of Statistics Canada.

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