Prospective comparison of risk factors for firearm suicide and non-firearm suicide in a large population-based cohort of current and former US service members: findings from the Millennium Cohort Study

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Summary

Background Suicide is a leading cause of death among service members and veterans. Among suicide methods, firearms are the most lethal and commonly used method among military populations. Limited research has compared risk factors for the various suicide methods. This study evaluated and compared risk factors for firearm versus non-firearm suicides using data from the Millennium Cohort Study, a large longitudinal military cohort.

Methods Using a competing risk approach, we identified factors associated with each suicide method. Risk factors included demographics, mental health diagnoses, mental health symptoms, military-specific characteristics, health behaviors, and psychosocial factors. Cause of death was assessed from July 1, 2001, through December 31, 2018.

Findings Among 201,565 eligible participants with a mean [SD] age of 29.0 [58.1] years, there were 139,789 (69.3%) male, 61,776 (30.7%) female, 15,927 (7.9%) Hispanic, 24,667 (12.3%) non-Hispanic Black, 14,138 (7.0%) Asian, Pacific Islander, American Indian or Multiracial, and 146,736 (72.8%) non-Hispanic White participants. During the study period, 330 died by firearm suicide and 168 died by non-firearm suicide. Overall, effect estimates for risk factors were similar across both methods of suicide. After adjustment, men (HR: 3.69, 95% CI: 2.59, 5.24) and those who screened positive for depression (HR: 1.97, 95% CI: 1.36, 2.87) had an elevated risk for firearm suicide. In contrast, those who self-reported a history of bipolar diagnosis (HR: 3.40, 95% CI: 1.76, 6.55) had significantly increased risk for non-firearm suicide.

Interpretation Findings suggest that prevention and intervention strategies overall may not need to be differentiated by specific demographic, military, or health factors. Targeted interventions that consider sex and mental health screens might have relative utility in preventing firearm related suicide risk compared with non-firearm suicide.

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Keywords: Cohort studies; Veterans; Suicide; Depression; Mental health; Risk factors; Health behavior

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Research in context

Evidence before this study

Among the United States (US) military and veteran communities, suicide is a public health concern. To assess the evidence prior to this study, we used PubMed and Google Scholar to search for papers on "suicide", "method", "firearm", "death", and "predictors", which were published before January 2023. This was supplemented by using synonymous search terms, conducting internet searches, searching references from the identified papers, and authors' knowledge of other related papers. The body of existing literature has revealed the complexity of this issue. Four studies assessed risk factors using data from the National Violent Death Reporting System and three studies relied on data from health care systems. A meta-analysis found that individuals with mental health diagnoses were less likely to die by a firearm suicide compared with non-firearm suicide; however, this analysis excluded studies conducted in the context of military conflicts. While evidence suggests risk factors may differ by suicide method, most of these studies have been limited to civilian populations using a cross-sectional design and relied on data from health care or state-based surveillance systems.

Added value of this study

This was the first prospective study to examine the difference in risk factors between firearm suicide and non-firearm suicides using self-reported data from a cohort of over 200,000 service members. Consistent with previous evidence, we found an association between mental health diagnoses and increased risk for non-firearm suicide; however, in contrast, self-reported depression symptoms increased the risk for firearm suicide. Findings underscore there were more similarities in risk factors across suicide methods than differences in this military population.

Implications of all the available evidence

With limited exceptions, suicide prevention strategies and intervention efforts focused on a specific suicide method may not need to be differentiated by specific demographic, military, or health factors in military populations. Nonetheless, as firearms are the most lethal and commonly used method, efforts focused on safe firearm storage practices and lethal means safety may decrease the probability of suicide among current and former service members.

Introduction

Suicide is a current public health concern among military service members and veterans. Despite significant national efforts at the highest levels of the United States (US) government to prevent suicide, annual rates among service members and veterans (i.e., 24.3 suicides per 100,000 active component service members in 2021; 31.7 per 100,000 veterans in 2020) have risen significantly in the last 20 years.[1,2]

Firearms are the most lethal among the various suicide methods as approximately 90% of suicidal acts with a firearm result in death.[3] Approximately two-thirds of suicides among service members and veterans are by firearm whereas only half of all suicides in the US general population are by firearm.[4] Even after adjustment for sex and age, veteran and military members are significantly more likely to die by firearm suicide than civilians.[4] This may be due to numerous factors, such as a higher likelihood to own personal firearms, as well as greater familiarity with and access to firearms.[5]

While some research has focused on identifying risk factors for different suicide methods, the majority of these studies have been limited to civilian populations.[6–8] Evidence suggests there are some distinct demographic characteristics of those who die by different suicide methods. Risk factors previously found to be associated with firearm suicide compared with non-firearm suicide among civilians include male sex, non-Hispanic White race and ethnicity, older age, and being married.[6,7] In addition, evidence from general populations suggests that those with a psychiatric diagnosis are more likely to die of a non-firearm suicide than a firearm suicide.[8,9] For example, a meta-analysis reported that individuals with mental health diagnoses were less likely to die by suicide with a firearm compared with non-firearm methods; however, this analysis excluded studies conducted in the context of military conflicts.[9] In a retrospective study among suicide decedents who utilized Veteran Health Administration services, veterans without a mental health or substance use diagnosis were more likely to die by firearm than those with a diagnosis.[10]

Given the limited research, there are several reasons a better understanding of differences in risk factors across suicide methods in military populations is needed. The implementation of lethal means safety interventions differs significantly by method. Further, some interventions, such as forcible removal of firearms from individuals at risk of self-harm, may be controversial and challenging to implement, and confer a variety of adverse clinical outcomes.[11] Thus, if firearm lethal means safety interventions could be targeted to individuals at highest risk of firearm suicide, this may increase the efficacy of these interventions.

This study expands on the existing body of research by analyzing prospective data from a large cohort of US service members. The objective was to evaluate and compare risk factors for firearm suicide versus non-firearm suicide, including demographics, mental health diagnoses, mental health symptoms, military-specific characteristics, health behaviors, and psychosocial factors. We hypothesized that risk factors, such as the presence of mental health conditions (e.g., depression), health behaviors (e.g., alcohol-related problems) and certain sociodemographic factors (e.g., male sex) would be associated with greater suicide risk. As prior research in civilian populations has showed distinct risk factors across suicide means, we hypothesized that some risk factors would differ by suicide method. However, based on the limited extant research, this exploratory study did not have *a priori* hypotheses regarding differences by suicide method. Results may be informative for developing lethal means safety interventions.

Methods

Study population

The Millennium Cohort Study is the largest and longest-running longitudinal study designed to examine the long-term health effects of military service. Between July 1, 2001 and April 4, 2013, the Millennium Cohort Study enrolled four separate panels of military personnel on active service rosters, representing all service branches and components.[12] The first enrollment panel of service members invited into the study (Panel 1) were from a probability-based sample of the entire military population (as of October 2000). Additional random samples of military personnel with 1–5 years of service were invited to join subsequent enrollment panels in 2004–06 (Panel 2), 2007–08 (Panel 3), and 2011–13 (Panel 4). In brief, participants completed a self-administered comprehensive survey at enrollment and are requested to complete a follow-up survey every 3–5 years thereafter, regardless of military service status (i.e., still serving or separated).

The current study population included service members from the first four panels, who completed a baseline survey (n = 201,619). Study participants were followed through 2018, even if they transitioned out of the military. Individuals with missing, unknown, or pending cause of death (n = 54) were excluded from all analyses. This study was approved by the Naval Health Research Center Institutional Review Board (protocol number NHRC.2000.0007) and followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline. Written or electronic informed consent was obtained from all participants.

Suicide

Cause of death was assessed during and after military service from July 1, 2001, through December 31, 2018, using two data sources (Armed Force Health Surveillance Division [AFHSD] Defense Medical Surveillance System [DMSS] and the Department of Defense and Veteran Affairs Suicide Data Repository [SDR]). The AFHSD DMSS obtains records from the Armed Forces Medical Examiner System (AFMES). This mortality dataset captures death records and cause of death information for all US active duty and activated Reserve and National Guard personnel, regardless of geographic location, as well as former military members who died while serving as civilians or contractors during military operations. The SDR combines information from various sources, including the National Death Index Plus, Defense Casualty Analysis System, and Military Veteran Mortality Database. When the cause of death was available from both sources, DMSS was used as the principal source unless the DMSS status was pending or unknown. DMSS code '3350' (i.e., self-harm by firearms) and SDR codes, identified using International Classification of Diseases, 10th Revision (ICD-10) codes 'X72'-'X74' (e.g., self-harm by handgun) were categorized as firearm suicides. Non-firearm suicides were determined with DMSS codes of '3310' (i.e., self-poisoning by drugs or other biological substances), '3330' (i.e., self-poisoning by gas or vapors), '3340' (i.e., self-harm by hanging, strangulation, or suffocation) '3360,' (i.e., self-harm by jumping from high places) and SDR ICD-10 codes of 'X60'-'X71' (e.g., self-poisoning, self-harm by hanging), and 'X75'-'X83' (e.g., self-harm by jumping from high places or motor vehicle crash). Note that no participants died of self-harm by unspecified means (e.g., 'X84') and suicides that occurred from late effects of intentional self-harm were set to missing and not included in this study (e.g., 'Y87.0').

Risk factors

The risk factors of interest were grouped into five domains: (1) demographics, (2) military characteristics, (3) health behaviors and psychosocial factors, (4) physical health factors, and (5) mental health factors. Unless otherwise specified, risk factors were assessed using self-reported baseline survey data; if data were missing, data from the subsequent survey cycles were used.

Demographics included age, sex, race and ethnicity, education, marital status, and enrollment panel. Age, sex, race, and ethnicity were obtained from Defense Manpower Data Center (DMDC) personnel files. Information on sex, race, and ethnicity was provided by service members using categories defined by each of the service branches; the race and ethnicity categories have changed over time and differ by service branch. Thus, race and ethnicity were combined into the following 4 categories: Asian, Pacific Islander, American Indian,

Alaska Native, or Multiracial; Black non-Hispanic; Hispanic; and White non-Hispanic. Sex was categorized as female or male. Enrollment panel was based on when participants enrolled in the cohort.

Military characteristics included service component (Active duty, National Guard/Reserve), military rank (enlisted, officer), and service branch (Army, Navy/Coast Guard, Air Force, Marine Corps) obtained from DMDC personnel files. Deployment/combat experience was operationalized as a four-category variable: not deployed, deployed with no combat, deployed with combat, and deployed with combat unknown. Deployment dates, post 9/11 (September 11, 2001), were obtained from DMDC records. Among those who deployed during the study period, combat experience was assessed using all available data from the Millennium Cohort and the Post-Deployment Health Assessment (PDHA) surveys. The Millennium Cohort survey includes two sets of questions; a 13-item measure that captures experiences encountered during deployment (e.g., being attacked or ambushed, receiving small arms fire) and a 5-item measure that assesses combat-related experiences (e.g., exposure to dead and/or decomposing bodies). The PDHA survey is administered to all service members within 30 days of returning from deployment; PDHA data were obtained from AFHSD. If deployed participants positively endorsed any combat item, they were classified as deployed with combat, otherwise, they were classified as deployed without combat. For participants who deployed during the study period, and did not complete any combat measures, they were categorized as deployed with unknown combat status.

Health behaviors and psychosocial factors included smoking, risky drinking, alcohol-related problems, sleep duration, social support, and life stressors. Smoking status was classified into three categories (never smoked, previously smoked, currently smokes).[13] Risky drinking was assessed based on screening positive for heavy weekly drinking (>14 drinks per week for men, >7 drinks per week for women) or heavy episodic drinking (≥5 drinks for men, ≥4 drinks for women in one given day of the week or ≥5 drinks on at least one day or occasion during the past year). Alcohol-related problems were captured by endorsement of at least one of the five items assessing problem drinking in the past year from the Patient Health Questionnaire (PHQ).[14] Sleep duration was assessed based on the number of hours of sleep in an average 24-h period in the last month (categorized as less than 6 h/10 h or more, 6 h, or 7–9 h). Social support was assessed using a single PHQ item to evaluate how bothered they were in the last 4 weeks regarding 'having no one to turn to when you have a problem'.[13] Life stressors that ever occurred in participant's lifetime, were assessed using six items (e.g., divorce/separation, sexual assault, major financial problems) from an adapted version of the Holmes and Rahe Stress Social Readjustment Rating Scale.[15]

Physical health factors included body mass index (BMI), multiple somatic symptoms, and bodily pain. BMI was assessed using self-reported height and weight, categorized as normal (<25.0 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (≥30.0 kg/m^2). Multiple somatic symptoms were assessed using 15 items from the PHQ assessing physical health symptoms in the last 4 weeks and represented by a two-level categorical variable: 0–4 symptoms and 5 or more symptoms.[16] Bodily pain in the last 4 weeks was based on the two-item bodily pain scale from the Short Form 36-Health Survey for Veterans (VR-36; range 0–100),[17] categorized into tertiles representing low, medium, and high bodily pain.

Mental health factors included assessments of PTSD, depression, panic/anxiety, and bipolar disorder. Probable PTSD was assessed using the 17-item PTSD Checklist-Civilian Version (PCL-C) and scored based on the Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition criteria (DSM-IV; endorsing moderate or greater on ≥ one intrusion, ≥two hyperarousal, and ≥three avoidance symptoms in the past month).[18] Probable depression was assessed using the PHQ-8, a validated screening instrument based on DSM-IV criteria (reported "more than half the days" or "nearly every day" to five or more of the eight depressive symptoms in the last 2 weeks, of which one item was depressed mood or anhedonia).[19] Probable panic/anxiety disorder was based on a positive screen for either other anxiety syndrome or panic disorder, assessed using additional PHQ subscales based on symptoms in the last 4 weeks.[19] Anxiety was coded if participants reported 'more than half the days' to the first item 'feeling nervous, anxious, on edge, or worrying a lot about different things' and three or more of the six remaining items (e.g., getting tired very easily, easily annoyed). Panic disorder was coded if a participant endorsed 'yes' to the first four items (e.g., experiencing anxiety attacks, attacks bother you a lot) and four or more of the remaining eleven items related to the last bad anxiety attack (e.g., short of breath, felt dizzy, tremble, or shake). Self-reported history of three mental health diagnoses was also assessed (i.e., based on the report if their doctor or another health professional ever told them they had): (1) manic-depressive disorder (henceforth bipolar disorder), (2) PTSD, or (3) depression.

Statistical analysis

Descriptive analyses compared frequencies of each risk factor by suicide method. Cause-specific Cox proportional hazards regression models, a competing risk approach that accounts for length of time to the event (suicide), were used to identify factors associated with each suicide method. Hazard ratios (HRs) and 95% confidence intervals (CIs) were estimated for firearm suicides and non-firearm suicides. Wald x^2 tests were subsequently conducted to directly compare differences

in HRs for each factor across suicide means, consistent with prior research and recommendations.[20]

Due to the number of risk factors and to remove irrelevant factors for interpretability, the final multivariable Cox models were derived using a manual backward elimination process. Initially, all factors were included in the multivariable model (see Table 1 for list of variables). Variables were manually removed, one variable at a time, sequentially until the final multivariable model retained only variables significantly associated with the outcome ($p < 0.05$). To facilitate comparisons across suicide methods, we retained factors in the models if the p-value was <0.05 in either the firearm suicide or non-firearm suicide model. Age, a potential confounder, was retained in the model regardless of statistical significance.

Person-days for each participant were calculated from the completion date of their baseline survey (i.e., both the start date and time of origin), until the date of: (1) death (suicide or non-suicide) or (2) study completion (December 31, 2018), whichever occurred first; participants were censored at the date of a non-suicide death or at the end of the study period. For inclusion into each model, participants must have complete data for all variables in that model. Thus, the sample size for each model slightly differed as participants with missing data were removed; missingness for each factor ranged from 0% to 1.74%. In the final model (n = 195,257), 6308 participants (3.13%) were removed due to missing data. Proportional hazards assumptions were verified by assessing the correlation between the Schoenfeld residuals and person-days in the final multivariable models. Linearity for continuous variables (age) was checked by plotting the cumulative sums of martingale residuals against age, which verified the observed curve to be within the distribution of the simulated cumulative martingale residual curves. The factors did not indicate multicollinearity; all VIFS were below 3.15.

Supplemental analyses were conducted to examine: (1) association of sexual assault and suicide method, (2) association of combat severity and suicide method, (3) saturated model, which retained all factors in the final multivariable models, and (4) association of aggregated mental health diagnoses and aggregated mental health screens with suicide means (Supplementary Methods). The funders had no role in study design, data collection and analysis, interpretation of data, decision to publish, or preparation of the manuscript.

Results

The study population comprised of 201,565 service members who were predominantly men, non-Hispanic White, had at least some college education, enlisted, and were in the Army (Table 1). During the study period, 330 participants died by firearm suicide (12.9 per 100,000 person-years during a mean of 7.09 follow-up years [SD 4.33]), 168 died by non-firearm suicide (6.6 per 100,000 person-years during a mean of 7.30 follow-up years [SD 4.37]), 2465 died by non-suicide death (96.48 per 100,000 person-years during a mean of 9.14 follow-up years [SD 4.89]), and 198,602 were documented as alive by the end of the study period (mean follow-up of 12.73 follow-up years [SD 3.98]). Of the non-firearm suicides, the majority (90 [53.6%]) were by hanging, strangulation, or suffocation, followed by intentional self-poisoning by drugs and other substances (60 [35.7%]), while the remaining (18 [10.7%]) were by other methods. While all participants were actively serving in the military at the time of study enrollment, of the 498 participants who died by suicide, 37% occurred while serving (131 firearm suicides and 54 non-firearm suicide) and 63% occurred after transitioning out of the military (199 firearm suicides and 114 non-firearm suicides).

Results from the unadjusted hazards models are summarized in Table 2; overall, the effect estimates for risk factors across the two suicide methods appeared to be comparable. Specifically, demographic factors associated with greater risk of firearm and non-firearm suicide included male sex, lower education attainment, single marital status, and enrollment in the most recent panel (Panel 4). Suicide risk for both methods appeared to decrease with older age. Non-Hispanic Black individuals had a lower risk of both suicide methods compared with Non-Hispanic White counterparts. Panel 3, compared with Panel 1, had increased risk of firearm suicide. Military characteristics associated with increased risk of a suicide by either method included enlisted rank (compared with officers), serving in the Army or Marine Corps (compared with Air Force), and previous deployment with combat experience (compared with deployed without combat). Navy or Coast Guard personnel, compared with Air Force personnel, had a lower risk of firearm suicide; those who did not deploy and deployed with unknown combat status (compared with deployed without combat) had increased risk of suicide by both methods, but these effect estimates had limited precision for firearm suicide. All health behaviors, psychosocial factors, and mental health factors of interest were associated with elevated risks of both firearm and non-firearm suicide (e.g., smoking, alcohol-related problems, life stressors, lack of social support, probable PTSD, history of depression diagnosis). For physical health factors, bodily pain and multiple somatic symptoms were associated with both suicide methods. Those with overweight or obesity had a lower risk of firearm and non-firearm suicide, though the associations between BMI and firearm suicide had limited precision.

The final adjusted models included 195,257 participants, with 308 firearm suicides and 156 non-firearm suicides (Table 3). Risk factors that remained in the final reduced model included age, sex, panel, service

	No suicide		Firearm suicide		Non-firearm suicide	
	n	%[b]	n	%[b]	n	%[b]
Demographic factors						
Age, years at baseline, mean (SD)	29.0 (8.1)		27.5 (7.5)		28.6 (7.6)	
Sex						
Male	139,372	(69.3)	288	(87.3)	129	(76.8)
Female	61,695	(30.7)	42	(12.7)	39	(23.2)
Race/ethnicity						
Asian, Pacific Islander, American Indian, Alaska Native, or Multiracial	14,107	(7.0)	15	(4.6)	16	(9.5)
Black, non-Hispanic	24,632	(12.3)	26	(7.9)	9	(5.4)
Hispanic	15,897	(7.9)	18	(5.5)	12	(7.1)
White, non-Hispanic	146,334	(72.8)	271	(82.1)	131	(78.0)
Educational attainment						
High school degree or less	43,332	(21.6)	99	(30.0)	50	(29.8)
Some college	106,994	(53.2)	191	(57.9)	92	(54.8)
Bachelor's degree or higher	50,722	(25.2)	40	(12.1)	26	(15.5)
Marital status						
Single/never married	69,086	(34.4)	138	(41.8)	66	(39.3)
Currently married	109,501	(54.5)	157	(47.6)	71	(42.3)
Widowed/divorced/separated	22,472	(11.2)	35	(10.6)	31	(18.5)
Panel						
Panel 1 (2001–2003)	76,796	(38.2)	122	(37.0)	76	(45.2)
Panel 2 (2004–2006)	31,026	(15.4)	43	(13.0)	30	(17.9)
Panel 3 (2007–2008)	43,308	(21.5)	90	(27.3)	30	(17.9)
Panel 4 (2011–2013)	49,937	(24.8)	75	(22.7)	32	(19.1)
Military characteristics						
Service component						
Reserve/National Guard	67,989	(33.8)	105	(31.8)	50	(29.8)
Active duty	133,078	(66.2)	225	(68.2)	118	(70.2)
Rank						
Enlisted	166,900	(83.0)	301	(91.2)	151	(89.9)
Officer	34,167	(17.0)	29	(8.8)	17	(10.1)
Service branch						
Army	89,614	(44.6)	174	(52.7)	93	(55.4)
Navy/Coast Guard	35,782	(17.8)	30	(9.1)	24	(14.3)
Marine Corps	17,987	(9.0)	46	(13.9)	19	(11.3)
Air Force	57,684	(28.7)	80	(24.2)	32	(19.1)
Deployment/combat experience[c]						
Not deployed	70,528	(35.1)	114	(34.6)	72	(42.9)
Deployed, no combat	32,649	(16.2)	39	(11.8)	12	(7.1)
Deployed, with combat	94,406	(47.0)	170	(51.5)	79	(47.0)
Deployed, unknown combat	3484	(1.7)	7	(2.1)	5	(3.0)
Health behaviors and psychosocial factors						
Smoking status						
Never smoked	113,201	(56.3)	117	(35.5)	52	(31.0)
Previously smoked	45,766	(22.8)	90	(27.3)	55	(32.7)
Currently smokes	38,611	(19.2)	112	(33.9)	53	(31.6)
Alcohol-related problems[d]						
No	172,034	(85.6)	236	(71.5)	117	(69.6)
Yes	26,286	(13.1)	86	(26.1)	44	(26.2)
Risky drinking[e]						
No	91,268	(45.4)	110	(33.3)	57	(33.9)
Yes	106,595	(53.0)	211	(63.9)	103	(61.3)

(Table 1 continues on next page)

	No suicide		Firearm suicide		Non-firearm suicide	
	n	%[b]	n	%[b]	n	%[b]
(Continued from previous page)						
Sleep duration, hours						
<6 and 10+	48,522	(24.1)	120	(36.4)	60	(35.7)
6	59,892	(29.8)	80	(24.2)	41	(24.4)
7–9	90,162	(44.8)	120	(36.4)	64	(38.1)
Life stressors[f]						
None	116,878	(58.1)	166	(50.3)	69	(41.1)
1 or more	81,488	(40.5)	156	(47.3)	93	(55.4)
Social support						
Not bothered	158,704	(78.9)	225	(68.2)	111	(66.1)
Bothered a little	29,170	(14.5)	66	(20.0)	31	(18.5)
Bothered a lot	11,799	(5.9)	35	(10.6)	23	(13.7)
Physical health factors						
BMI						
Normal weight (<25.0 kg/m^2)	85,779	(42.7)	149	(45.2)	87	(51.8)
Overweight (25.0–29.99 kg/m^2)	93,066	(46.3)	150	(45.5)	63	(37.5)
Obese (>30.0 kg/m^2)	20,929	(10.4)	27	(8.2)	17	(10.1)
Bodily pain						
Low	55,044	(27.4)	66	(20.0)	38	(22.6)
Medium	80,665	(40.1)	126	(38.2)	54	(32.1)
High	63,266	(31.5)	131	(39.7)	72	(42.9)
Multiple somatic symptoms						
None/mild	128,435	(63.9)	179	(54.2)	83	(49.4)
Moderate/severe	71,130	(35.4)	148	(44.9)	81	(48.2)
Mental health factors						
Probable PTSD (PCL-C)[g]						
No	184,487	(91.8)	264	(80.0)	132	(78.6)
Yes	14,608	(7.3)	58	(17.6)	33	(19.6)
History of PTSD diagnosis						
No	191,355	(95.2)	293	(88.8)	153	(91.1)
Yes	7863	(3.9)	32	(9.7)	12	(7.1)
Probable depression (PHQ-8)[h]						
No	190,533	(94.8)	278	(84.2)	148	(88.1)
Yes	9492	(4.7)	45	(13.6)	17	(10.1)
History of major depression diagnosis						
No	180,262	(89.7)	264	(80.0)	118	(70.2)
Yes	19,149	(9.5)	63	(19.1)	48	(28.6)
Probable panic/anxiety (PHQ)[i]						
No	190,196	(94.6)	289	(87.6)	141	(83.9)
Yes	9929	(4.9)	37	(11.2)	24	(14.3)
History of bipolar diagnosis						
No	197,478	(98.2)	318	(96.4)	151	(89.9)
Yes	1684	(0.8)	6	(1.8)	12	(7.1)

PCL-C, PTSD checklist-Civilian Version; PHQ, Patient Health Questionnaire; PTSD, posttraumatic stress disorder. [a]All characteristics except deployment/combat were assessed at study enrollment; all characteristics, except service component and BMI were $p < 0.05$. [b]Some columns do not sum to 100 due to missing data. [c]Deployment/combat history assessed throughout the study period. [d]Endorsement of one or more item on the PHQ alcohol items. [e]Assessed based on >14 drinks per week for men (>7 drinks per week for women) or ≥5 drinks for men (≥4 drinks for women) in one given day of the week or ≥5 drinks on at least one day or occasion during the past year. [f]Endorsed one of more of the following: disabling illness/injury, divorce/separation, major financial problems, violent assault, sexual harassment, sexual assault. [g]Assessed using the PCL-C. [h]Assessed using the PHQ depression items. [i]Assessed using the PHQ panic syndrome and other anxiety items.

Table 1: **Characteristics[a] of Millennium Cohort Study participants stratified by suicide methods (N = 201,565).**

	Firearm suicide			Non-firearm suicide		
	HR	95% CI	*p*	HR	95% CI	*p*
Demographic factors						
Age (5-year increments)	0.82	(0.76, 0.88)	<0.0001	0.91	(0.83, 1.00)	0.052
Sex (ref: Female)	3.04	(2.20, 4.20)	<0.0001	1.47	(1.03, 2.11)	0.035
Race/Ethnicity (Ref: White, non-Hispanic)			0.0035			0.026
Asian, Pacific Islander, American Indian, Alaska Native, or Multiracial	0.61	(0.36, 1.03)		1.35	(0.80, 2.27)	
Black, non-Hispanic	0.55	(0.37, 0.83)		0.40	(0.20, 0.78)	
Hispanic	0.64	(0.39, 1.02)		0.88	(0.49, 1.59)	
Educational attainment (Ref: ≥Bachelor's degree)			<0.0001			0.0014
High school degree or less	3.10	(2.15, 4.48)		2.40	(1.50, 3.86)	
Some college/Associate's degree	2.39	(1.70, 3.36)		1.77	(1.15, 2.74)	
Marital status (Ref: Married)			0.0031			0.0009
Never married	1.48	(1.18, 1.86)		1.56	(1.11, 2.18)	
Divorced/Separated/Widowed	1.09	(0.75, 1.57)		2.13	(1.40, 3.25)	
Panel (Ref: Panel 1, 2001–2003)			<0.0001			0.065
Panel 2 (2004–2006)	1.13	(0.79, 1.61)		1.21	(0.78, 1.86)	
Panel 3 (2007–2008)	2.30	(1.70, 3.12)		1.03	(0.66, 1.61)	
Panel 4 (2011–2013)	2.94	(2.09, 4.12)		1.85	(1.15, 2.95)	
Military characteristics						
Service component (Ref: Reserve/National Guard)						
Active duty	1.21	(0.96, 1.53)	0.105	1.34	(0.96, 1.86)	0.086
Rank (Ref: Officer)						
Enlisted	2.28	(1.56, 3.34)	<0.0001	1.95	(1.18, 3.22)	0.0092
Service branch (Ref: Air Force)			<0.0001			0.0062
Army	1.39	(1.07, 1.81)		1.86	(1.25, 2.78)	
Navy/Coast Guard	0.60	(0.40, 0.92)		1.20	(0.71, 2.04)	
Marine Corps	2.02	(1.41, 2.91)		2.07	(1.17, 3.66)	
Deployment/combat experience (Ref: Deployed, no combat)			0.046			0.017
Not deployed	1.20	(0.84, 1.73)		2.47	(1.34, 4.55)	
Deployed, combat	1.53	(1.08, 2.16)		2.31	(1.26, 4.24)	
Deployed, combat unknown	1.71	(0.77, 3.83)		3.98	(1.40, 11.29)	
Health behaviors and psychosocial factors						
Smoking Status (Ref: Never smoked)			<0.0001			<0.0001
Previously smoked	1.89	(1.44, 2.49)		2.60	(1.78, 3.80)	
Currently smokes	2.82	(2.18, 3.66)		3.00	(2.05, 4.40)	
Alcohol-related problems[a]	2.40	(1.87, 3.07)	<0.0001	2.47	(1.75, 3.50)	<0.0001
Risky drinking[b]	1.72	(1.36, 2.16)	<0.0001	1.61	(1.17, 2.23)	0.0038
Sleep duration (Ref: 7–9 h)			<0.0001			0.0005
<6 h/>10 h	1.98	(1.54, 2.55)		1.86	(1.31, 2.65)	
6 h	1.01	(0.76, 1.34)		0.97	(0.66, 1.44)	
Life stressors[c]	1.26	(1.01, 1.57)	0.040	1.81	(1.32, 2.47)	0.0002
Social support (Ref: Not bothered)			<0.0001			<0.0001
Bothered a little	1.60	(1.21, 2.10)		1.52	(1.02, 2.26)	
Bothered a lot	2.18	(1.52, 3.11)		2.90	(1.85, 4.55)	
Physical health factors						
BMI (Ref: Normal weight, <25.0 kg/m^2)			0.339			0.035
Overweight (25.0, –29.99 kg/m^2)	0.90	(0.72, 1.14)		0.65	(0.47, 0.90)	
Obese (>30.0 kg/m^2)	0.75	(0.50, 1.13)		0.81	(0.48, 1.36)	
Bodily pain (Ref: Low)			0.0008			0.0029
Medium	1.26	(0.94, 1.70)		0.94	(0.62, 1.42)	
High	1.73	(1.28, 2.32)		1.65	(1.11, 2.44)	
Multiple somatic symptoms (Ref: None/mild)						
Moderate/severe	1.56	(1.25, 1.93)	<0.0001	1.84	(1.35, 2.50)	0.0001

(Table 2 continues on next page)

	Firearm suicide			Non-firearm suicide		
	HR	95% CI	*p*	HR	95% CI	*p*
(Continued from previous page)						
Mental Health Factors						
Probable PTSD (PCL-C)[d]	3.15	(2.37, 4.19)	<0.0001	3.59	(2.45, 5.27)	<0.0001
History of PTSD diagnosis	3.34	(2.32, 4.81)	<0.0001	2.42	(1.34, 4.36)	0.0033
Probable depression (PHQ-8)[e]	3.55	(2.59, 4.86)	<0.0001	2.52	(1.52, 4.16)	0.0003
History of major depression diagnosis	2.43	(1.85, 3.20)	<0.0001	4.16	(2.97, 5.82)	<0.0001
Probable panic/anxiety (PHQ)[f]	2.83	(2.01, 3.99)	<0.0001	3.78	(2.45, 5.83)	<0.0001
History of bipolar diagnosis	2.25	(1.00, 5.05)	0.049	9.50	(5.28, 17.10)	<0.0001

PCL-C, PTSD checklist-Civilian Version; PHQ, Patient Health Questionnaire; PTSD, posttraumatic stress disorder. [a]Endorsement of one or more item on the PHQ alcohol items. [b]Assessed based on >14 drinks per week for men (>7 drinks per week for women) or ≥5 drinks for men (≥4 drinks for women) in one given day of the week or ≥5 drinks on at least one day or occasion during the past year. [c]Endorsed one of more of the following: disabling illness/injury, divorce/separation, major financial problems, violent assault, sexual harassment, sexual assault. [d]Assessed using the PCL-C. [e]Assessed using the PHQ depression items. [f]Assessed using the PHQ panic syndrome and other anxiety items.

Table 2: **Unadjusted hazard ratios for firearm and non-firearm suicide among Millennium Cohort Study participants.**

branch, deployment/combat experience, smoking status, alcohol-related problems, life stressors, BMI, probable depression, history of depression diagnosis, and history of bipolar disorder. In general, the association with firearm and non-firearm suicide in the adjusted models were comparable for most factors; specifically, the magnitudes of the HRs across suicide means were similar and did not appear to differ across suicide methods (based the Wald x^2 tests). Older age was associated with decreased risk and Panel 4 enrollment with increased risk for both suicide methods, but these effect estimates had limited precision for non-firearm suicide. Compared to those who deployed without combat, individuals with any other deployment/combat experience, including non-deployers, had increased risk of suicide across both suicide methods, but these associations had limited precision for firearm suicide. Adverse health behaviors and psychosocial factors appeared to be associated with a greater risk of both firearm and non-firearm suicide (e.g., smoking, alcohol-related problems, life stressors). Those with overweight or obesity had a lower risk of firearm and non-firearm suicide; however, the associations between overweight and firearm suicide and obesity and non-firearm suicide had limited precision.

Based on Wald x^2 tests and differences in the magnitude of the HRs, evidence indicated that four factors differed between firearm and non-firearm suicides: Panel 3 enrollment, sex, probable depression based on the PHQ-8, and history of a bipolar diagnosis. Specifically, men had an elevated risk for suicide, compared with women, for both methods; however, the magnitude of the association appeared to be stronger, a 3-fold increase, for suicide by firearms (HR: 3.69, 95% CI: 2.59, 5.24) compared with suicide by non-firearm, a 2-fold increase (HR: 1.94, 95% CI: 1.30, 2.90). Compared to participants enrolled between 2001 and 2003 (Panel 1), participants enrolled between 2007 and 2008 (Panel 3) had an elevated risk for firearm suicide (HR: 1.88, 95% CI: 1.32, 2.67), but this association was not detected in the non-firearm suicide model (HR: 0.94, 95% CI: 0.56, 1.56). Probable depression increased risk for firearm suicide (HR: 1.97, 95% CI: 1.36, 2.87), but did not appear to be associated with non-firearm suicide (HR: 0.78, 95% CI: 0.44, 1.40). While a history of a bipolar diagnosis increased risk for non-firearm suicide (HR: 3.40, 95% CI: 1.76, 6.55), this estimate was not precise. A history of a bipolar diagnosis did not appear to be associated with increased risk for firearm suicide (HR: 0.91, 95% CI: 0.39, 2.12).

While the HRs for the remaining factors did not appear to differ across suicide methods, based on the Wald x^2 test, there are two comparisons worth noting. Individuals serving in the Navy or Coast Guard had a lower risk of firearm suicide compared with Air Force personnel (HR: 0.52, 95% CI: 0.34, 0.80) while no association was observed for non-firearm suicide (HR: 1.00, 95% CI: 0.58, 1.71). A history of a depression diagnosis increased risk for both firearm (HR: 1.69, 95% CI: 1.20, 2.37) and non-firearm suicide (HR: 2.75, 95% CI: 1.81, 4.18), but the magnitude of association was greater for non-firearm suicide.

Supplemental analyses

In the adjusted models, no associations were observed between sexual assault and suicide (Supplementary Results). Results from the adjusted models examining combat severity were generally consistent with the deployment/combat results from the final reduced models (Supplementary Table S1).

When all factors were retained (n = 191,404) in the multivariable models, results were generally consistent with the final reduced models, except Asian, Pacific Islander, American Indian, Alaskan Native or Multiracial individuals appeared to have an increased risk for non-firearm suicide, while they had a reduced risk of

	Firearm suicide (n = 308)			Non-firearm suicide (n = 156)			Comparison of suicide methods	
	HR	95% CI	p	HR	95% CI	p	χ^2	p
Demographic factors								
Age (5-year increments)	0.85	(0.78, 0.94)	0.0010	0.90	(0.80, 1.01)	0.085	0.47	0.494
Sex (ref: Female)	3.69	(2.59, 5.24)	<0.0001	1.94	(1.30, 2.90)	0.0011	5.56	0.018
Panel (Ref: Panel 1, 2001–2003)			<0.0001			0.436		
Panel 2 (2004–2006)	0.86	(0.58, 1.29)		0.96	(0.58, 1.59)		0.11	0.738
Panel 3 (2007–2008)	1.88	(1.32, 2.67)		0.94	(0.56, 1.56)		4.88	0.027
Panel 4 (2011–2013)	2.19	(1.50, 3.19)		1.43	(0.84, 2.43)		1.63	0.201
Military characteristics								
Service branch (Ref: Air Force)			0.0037			0.546		
Army	1.10	(0.82, 1.46)		1.28	(0.83, 1.95)		0.34	0.562
Navy/Coast Guard	0.52	(0.34, 0.80)		1.00	(0.58, 1.71)		3.52	0.061
Marine Corps	0.99	(0.66, 1.47)		1.00	(0.53, 1.90)		0.00	0.976
Deployment/combat experience (Ref: Deployed, no combat)			0.149			0.027		
Not deployed	1.30	(0.88, 1.93)		2.61	(1.28, 5.30)		2.80	0.094
Deployed, combat	1.05	(0.72, 1.53)		2.04	(1.00, 4.13)		2.61	0.106
Deployed, combat unknown	2.00	(0.89, 4.94)		4.18	(1.28, 13.62)		1.02	0.312
Health behaviors and psychosocial factors								
Smoking status (Ref: Never smoked)			<0.0001			0.0002		
Previously smoked	1.66	(1.25, 2.21)		2.14	(1.45, 3.17)		1.07	0.301
Currently smokes	1.97	(1.50, 2.60)		2.04	(1.36, 3.05)		0.02	0.895
Alcohol-related problems[a]	1.47	(1.12, 1.93)	0.0050	1.56	(1.07, 2.27)	0.019	0.06	0.806
Life stressors[b]	1.35	(1.05, 1.72)	0.017	1.50	(1.06, 2.12)	0.022	0.25	0.615
Physical health factors								
BMI (Ref: Normal weight)			0.022			0.0091		
Overweight (25.0, –29.99 kg/m^2)	0.82	(0.64, 1.04)		0.60	(0.42, 0.85)		2.09	0.149
Obese (>30.0 kg/m^2)	0.56	(0.36, 0.87)		0.60	(0.34, 1.05)		0.04	0.848
Mental health factors								
Probable depression (PHQ-8)[c]	1.97	(1.36, 2.87)	0.0004	0.78	(0.44, 1.40)	0.407	6.86	0.0088
History of major depression diagnosis	1.69	(1.20, 2.37)	0.0024	2.75	(1.81, 4.18)	<0.0001	3.16	0.075
History of bipolar diagnosis	0.91	(0.39, 2.12)	0.831	3.40	(1.76, 6.55)	0.0003	5.81	0.016

PHQ, Patient Health Questionnaire. *Note.* Variables were manually removed from the model until all variables had p < 0.05 in at least one suicide method model for comparison purposes. Model selection process dropped variables in the following order: Risky drinking, service component, paygrade, social support, multiple somatic symptoms, bodily pain, history of PTSD diagnosis, probable anxiety, education, race and ethnicity, marital status, sleep duration, and probable PTSD. [a]Endorsement of 1 or more item on the PHQ alcohol items. [b]Endorsed one of more of the following: disabling illness/injury, divorce/separation, major financial problems, violent assault, sexual harassment, sexual assault. [c]Assessed using the PHQ depression items.

Table 3: **Adjusted hazard ratios for firearm and non-firearm suicide among Millennium Cohort Study participants (n = 195,257).**

firearm suicide compared with White, non-Hispanic individuals (Supplementary Table S2).

When the aggregated mental health variables were included in saturated models, reporting any mental health diagnoses (i.e., depression, PTSD, bipolar disorder) was associated with suicide for both methods; based on the Wald x^2 test, this association appeared to be greater in magnitude for non-firearm suicide (Supplementary Table S3). Screening positive for any probable mental health condition (i.e., depression, PTSD, panic/anxiety disorder) appeared to increase the risk of suicide, although the effect estimate had limited precision for non-firearm suicide; the magnitudes of association did not appear to differ based on Wald x^2 test.

Discussion

To our knowledge, this is one of the most comprehensive studies examining differences in risk factors associated with firearm suicides compared with non-firearm suicides among US service members. This study expanded on prior research by prospectively analyzing up to 17 years of longitudinal data from over 200,000 US service members. Our analyses revealed that, overall, the magnitudes of associations for risk factors were generally similar across the two suicide methods. However, men had a significantly higher risk of firearm suicide compared with non-firearm suicide. In addition, a history of mental health diagnosis, specifically bipolar diagnosis, was a predictor of non-firearm suicide, while self-reported depression symptoms were associated with

increased risk of a firearm suicide. These findings underscore that there are far more similarities in a large array of risk factors by suicide method than differences. Taken together, with few exceptions, suicide prevention strategies and intervention efforts focused on a specific suicide method may not need to be differentiated by specific demographic, military, or health factors. Nonetheless, since firearms are the most lethal and commonly used method among service members and veterans, focusing efforts on safe firearm storage practices, lethal means safety, and counseling to prevent suicides due to firearms may increase the probability of long-term survival for service members and veterans.

Consistent with findings from other studies, men had a higher risk of suicide than women[6,7] while the magnitude of association was stronger for firearm suicide compared with non-firearm suicide. These sex differences in suicide methods may, in part, be driven by differences in socialization and sex roles. It is theorized that socialization and sex roles may decrease the likelihood of women owning, having access to, and/or being familiar with firearms relative to men. Even in the US military, where the number of service women has steadily increased for decades, it was not until January 2016 that restrictions on women serving in combat-specific occupations were fully rescinded.[21] Traditionally, female service members and veterans in all military occupations have been less likely to experience combat (25.5%) compared with their male counterparts (39.7%).[22] Service women are more likely to serve in administrative, financial, and healthcare positions, while men are more likely to be combat specialists or combat support rolls.[22] Sex/gender socialization may also play a role in women's concerns over physical disfigurement of their bodies. One prior study found that women were less likely to shoot themselves in the head compared with men when attempting suicide by firearms.[23] While speculative, it is possible that women may have a stronger desire to preserve their appearance and/or be more sensitive to the profound negative impact of their next of kin finding a disfigured or unrecognizable body.[24]

While other demographic and military factors were significantly associated with suicide risk, such as age, service branch, and combat/deployment experience, the majority of these associations did not appear to differ by suicide method. However, compared to Panel 1 participants (enrolled between 2001 and 2003), Panel 3 and 4 participants (enrolled between 2007–2008, and 2011–2013, respectively) had an increased risk of firearm suicide. This may indicate a cohort or age effect, in which individuals who joined the military more recently, had fewer years of service, or were born later had an increased likelihood to die by a firearm suicide. Thus, firearm-specific interventions, including lethal means safety, for men and younger service members with fewer years of service may be particularly important given the higher risk of suicide by firearm among these groups.

In unadjusted models, participants who screened positive or had a diagnosis for any of the selected mental disorders had an increased risk of both firearm and non-firearm suicide. For the most part, the magnitude of these associations was stronger for those with a non-firearm suicide compared with firearm suicide in the unadjusted analyses. After adjustment, these associations were attenuated, and only two appeared to have a statistically significant difference by suicide method. Those who reported a prior diagnosis of depression or bipolar disorder had a higher magnitude of risk for non-firearm suicide compared with firearm suicide, although this difference was not detected to be significantly different for depression. Evidence from the supplemental analyses also supported this difference; those with a non-firearm suicide were more likely to have a prior mental health diagnosis. This aligns with evidence suggesting that those with a mental health diagnosis are more likely to die by a non-firearm suicide.[8] For example, a previous meta-analysis found that those with a depression diagnosis were less likely to die by firearm suicide.[9] It is possible that those who use non-firearm methods for suicide attempt may be less impulsive and more likely to seek and receive mental health care.[25] In addition, those with a mental health diagnosis, may be more likely to have access to psychotropic prescribed medicine, which could be used for intentional self-poisoning.

Conversely, we found that those who screened positive for depression, based on self-reported symptoms on the PHQ-8, were more likely to die by firearm suicide. Further, evidence from the supplemental analyses also detected an association between screening positive for one or more of the mental health screeners (i.e., PTSD, depression, panic/anxiety) and firearm suicide. While this may seem counterintuitive, it may indicate that those who died by firearm suicide were more likely to be experiencing mental health symptoms but less likely to seek help for those symptoms. A previous study found that those who died by firearm suicide were less likely to seek mental health treatment and more likely to die on their first suicide attempt.[25] While firearm suicide decedents may be less likely to have a known mental health diagnosis,[26] underlying mental health symptoms are likely to still be contributing to risk; the absence of a diagnosis does not indicate the absence of mental health symptoms. Impulsivity may also play a role. Those using firearms for suicide may have less time to seek and receive mental health treatment before an initial attempt. Moreover, those who have access to and are familiar with guns are more likely to hold traditional masculine norms,[27] which has been linked to a lower likelihood of engaging in mental health treatment.[28] To our knowledge, this was one of the first studies that relied on self-reported mental health symptoms in

addition to a history of mental diagnoses to assess differences in suicide risk factors by method. Although these differences are subtle, future research is needed to confirm these results. Findings may support mental health screening as one aspect of comprehensive suicide prevention efforts.

Smoking, alcohol-related problems, and life stressors were associated with an increased risk of firearm and non-firearm suicide, and these estimates of association did not appear to significantly differ across suicide methods. Prior evidence indicates that those who formerly smoked or currently smoke had an increased risk of suicide relative to those who never smoked.[29] While the mechanism and nature of this association are still not clearly understood, smoking may have psychological and physiological effects, such as elevated oxidative stress or lower serotonin levels[29]; research also suggests that tobacco-related disease, such as cancer and cardiovascular disease, are associated with increased suicide risk.[30] Regardless of the mechanism, smoking may be an important modifiable risk factor for downstream suicidal behaviors. The association of life stressors with both firearm and non-firearm suicide is consistent with prior research linking stressful life events to suicidal ideation and behaviors.[31] Alcohol-related problems were also associated with a greater risk of suicide across both methods.[32] Alcohol use disorders are often comorbid with other psychiatric conditions, and the findings support alcohol screening and early intervention efforts.

Although the current study has several strengths, such as the use of a large, contemporary sample of US service members and the prospective examination of risk factors, certain limitations warrant mention. Due to the lower numbers of non-firearm suicides compared with firearm suicides, there was reduced power for identifying risk factors for non-firearm suicides. Furthermore, we could not disaggregate non-firearm suicides into more specific categories nor conduct sex or ethnic-specific analyses. Additionally, although the current study's sample size was sufficient to precisely estimate a multitude of risk factors for this rare event, some estimates, such as a history of bipolar disorder diagnosis, were estimated with less precision due to the low frequency of bipolar diagnoses within the study population. Another limitation was that other potential risks and protective factors for suicide were not assessed, including, gender identity, traumatic brain injury, burdensomeness, belongingness, and history of other mental health diagnoses (e.g., anxiety). We were not able to assess suicidal ideation, as this item was only available at baseline for the first three panels; it was removed in subsequent survey cycles based on requirements from the Institutional Review Board. Further, there were no data on ownership/access, familiarity with, and/or storage of firearms. However, data for some of these constructs, such as suicidal behaviors, firearm access, firearm storage, and gender identity, are starting to be collected on the Millennium Cohort survey. Non-firearm suicides may be underestimated due to misreporting deaths due to overdose or injury as accidental; however, it is unknown whether different risk factors pertain to these deaths. Most of the risk factors were based on self-reported baseline survey data. Social support was based on one item and may not fully capture the desired construct. These data do not necessarily capture changes in the health status, diagnoses in medical records, or behaviors of participants that may have occurred over the years and closer to the time of death. Further, nonresponse differed by age, sex, race and ethnicity; however, these differences were small, and prior investigations have found that nonresponse did not substantially change estimates of health outcomes.[33] The cause-specific method has some built-in selection bias and assumptions that may not have been fully met, including measuring all common risk factors, time-at-risk of suicide began at the study start time, and exchangeability of censoring. Lastly, the data are from an observational study, and thus unmeasured confounding may have biased the effect estimates.[34]

In conclusion, this was one of the first studies that relied on self-reported data to examine differences in suicide risk factors among US service members. With few exceptions, effect estimates for risk factors were generally similar between firearm and non-firearm suicides. Men were at a higher risk of suicide than women, and the association with sex was stronger for firearm suicide compared with non-firearm suicide. Consistent with prior research, a history of self-reported mental health diagnosis increased the risk of suicide, and this association was greater for non-firearm suicide. Findings indicated self-reported mental health symptoms increased the risk of firearm suicide, while these associations were not as strong nor consistent for non-firearm suicide. Thus, the absence of a mental health diagnosis among those with a firearm suicide may not indicate the absence of mental health symptoms. While findings indicate that targeted suicide prevention strategies that consider sex and mental health screening may be beneficial in reducing suicide, the implementation of lethal means safety interventions may not need to be differentiated by other demographic, military, or health factors. Regardless, given the high use and lethality of firearms, efforts that encourage and train safe firearm storage practices and lethal means safety should be an integral part of a comprehensive suicide prevention program for service members and veterans, and there may be value in considering sex-specific firearm safety educational strategies.

Contributors

All authors contributed to the study conception and design. CAL, NS, SW, and SKB performed the database extraction, data cleaning, and statistical analysis. The first draft of the manuscript was written by CAL, NS, SKB, MAR, and CWH. All authors provided critical revision of the

manuscript for intellectual content. All authors reviewed, edited, and approved the final version and agree to be accountable for all aspects of the work. CAL, NS, and SKB have directly accessed and verified the underlying data reported in the manuscript.

Data sharing statement

The datasets generated and/or analyzed during the current study are not publicly available due to security protocols and privacy regulations, but limited de-identified datasets may be made available on reasonable request by the contacting the study principal investigators. The Millennium Cohort Study dataset may be made available by the Naval Health Research Center Institutional Review Board (contact phone +1 619 553 8400).

Ethics approval and consent to participate

The Millennium Cohort Study was approved by the Naval Health Research Center Institutional Review Board (protocol number NHRC.2000.0007). All participants provided voluntary informed consent.

Declaration of interests

Edward J Boyko reported receiving payment or honoraria and support for travel to the Korean Diabetes Association and American Diabetes Association. All other authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.lana.2024.100802.

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