



## Review

## Suicide and substance use among female veterans: A need for research



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## ABSTRACT

**Background:** The number of female veterans is increasing. Veterans Administration (VA) enrollment increased over 40% from past eras. However, little research has focused on their mental health. We reviewed literature to examine associations of substance use with suicide in female veterans, identify research gaps, and inform future studies.

**Methods:** Google Scholar, Pub Med, and PsychINFO were searched using: substance use, female veteran, and suicide. Exclusion criteria (e.g., not discussing U.S. veterans) left 17 articles.

**Results:** Nine studies examined completed suicide among veterans. In most recent years, rates of deaths were greater for veterans than nonveterans, including females. Completed suicide was associated with past trauma, young age, and a mental disorder. Studies have often not addressed substance use. Three studies examined completed suicide among VA treated veterans without examining substance use as an associated factor. Rates of completed suicides were also higher among veterans than nonveterans, including females. A large proportion of females also had a mental diagnosis. Five studies examined substance use and attempted or completed suicide among VA treated veterans. Veterans in poor mental health had increased odds of suicide mortality; women with a substance use disorder (SUD) had a higher hazard ratio for completed suicide than men with a SUD. Engagement in substance abuse treatment decreased odds of suicide attempt among veterans.

**Conclusion:** Available data suggest that suicide rates are higher among female veterans than women in the general population. Substance use may increase the likelihood of suicidal behaviors among female veterans, particularly those with a mental diagnosis.

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## 1. Introduction

Women with military service are a growing population. They currently make up 11.3% of military personnel and 8% of veterans in the United States (U.S.; Batuman et al., 2011). Modern

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warfare increases women's exposure to trauma (Murdoch et al., 2006), and the mental health needs of female veterans are increasing (Goldberg, 2008). However, veteran's mental health research has traditionally focused on men, creating disparity in knowledge about women (Goldzweig et al., 2006). The psychiatric status of women who served in Operation Iraqi Freedom (OIF), Operation New Dawn (OND), and Operation Enduring Freedom (OEF) ( $N=299,548$  as of February 28, 2013) requires research to inform female veteran's mental health needs (Nunnink et al., 2010). Given the reported increase of suicide and substance use among veterans (Nunnink et al., 2010; Kang and Bullman, 2009) and identified associations between substance use and completed suicide (Allen et al., 2005), there is a compelling need to investigate suicide and substance use in the understudied female veteran population. To aid efforts, we conducted a literature review to:

- Examine the extent of suicide measures (ideation, suicidal behavior, completed suicide) among veterans, with a particular focus on female veterans,
- Examine the potential for an association between substance use and suicide measures in female veterans,
- Discuss reasons female veterans may be particularly likely to misuse substances and endorse suicide measures, and
- Identify research gaps for future research.

To provide context for this review, we begin with a background on substance use among female military personnel, the role substance use might play in increasing suicide, and the challenges in studying substance abuse and suicide among female veterans. We then review available findings on male and female veteran suicide, including suicide among those who use Veterans Administration (VA) services, with an emphasis on females and gender differences. We also review studies on associations between suicide and substance use, including substance use disorder (SUD), among veterans. Finally, we discuss factors that increase female veteran's vulnerability to suicide and substance use.

### 1.1. Female military service and substance use

Problematic substance use is prevalent in the military. In 2008, prevalence of binge drinking ( $\geq 5$  drinks in men;  $\geq 4$  drinks in women on  $\geq 1$  day in the past 30 days) ranged from 39% in the Air Force to 57.6% in the Marine Corp (Bray et al., 2009). Although problematic drinkers were more often male (Bray et al., 2009), Jacobson et al. (2008) assessed alcohol use among 48,481 active duty personnel (30% female) and found that women were 1.21 times more likely than men to begin heavy weekly drinking between baseline (July, 2001–June, 2003) and follow-up (June, 2004–February, 2006). In addition, 32% of women reported binge drinking, 8% heavy weekly drinking, and 7% alcohol related problems (Jacobson et al., 2008). Further, a 2005 survey of 1200 Army soldiers found that women engaged in unsafe drinking at a rate nearly twice that of men (9.1% vs. 5.1%; Lande et al., 2007).

Bray and Hourani (2007) analyzed 1980–2005 survey data collected from  $>150,000$  active duty service members and found that, while illicit drug use declined in the general military population from 1980 to 1998 before leveling off, past-month prevalence of illicit drug use among female soldiers increased from 1998 to 2002 (from 1.9% to 2.9%). Bray et al. (2009) further found that nonmedical prescription drug use increased through 2008 and that past-month prevalence of any illicit or nonmedical drug use was higher among females than males (13.3% vs. 11.7%, respectively).

Data from the 2004–2006 National Survey on Drug Use and Health (NSDUH) found that 5.8% of female veterans had a SUD (SAMHSA, 2007b). While lower than the 9.2% in the general population (individuals aged 12+ years) with a SUD in 2006

(SAMHSA, 2007a), the proportion of female veterans who engage in problem substance use is likely higher than estimated. Although more recent data were not available, a 1998 survey found that, among 1259 female Veterans Health Affairs (VHA) patients, 24% of respondents engaged in binge drinking. Of respondents who drank, 11% binge drank  $\geq 1$  time a month (Bradley et al., 2001). Similarly, 31.1% of female veterans treated by the VHA and surveyed in 1998 reported hazardous or problem drinking, and 4.9% reported past-year drug use (Davis et al., 2003).

### 1.2. Suicide and substance use

Depending on the study measures, suicide variables may include *ideation* (suicidal thoughts and contemplation), *behavior* (attempted suicide), or *completed suicide* (Kaplan et al., 2007a,b). Studies show an association between substance use (e.g., alcohol, opiates, inhalants) and increased odds of suicidal behaviors in the samples of general populations (Borges et al., 2000; Cherpitel et al., 2004; Wilcox et al., 2004). In 2009, almost one third of US Army suicide deaths involved prescription drug abuse; from 2003 to 2009, 45% of unsuccessful suicidal attempts were reported to involve alcohol or drug use (US Army, 2010).

Joiner (2005) proposed that, to commit suicide, people must perceive themselves a burden to others, feel they do not belong, and be physically capable of self-harm. Substance use may improve the likelihood of these factors. Substances may alter neurological pathways to increase impulsivity, triggering suicidal behavior (Braquehais et al., 2010). Veterans suffering from posttraumatic stress disorder (PTSD) may also use substances to relieve PTSD symptoms (Leeies et al., 2010; Jakupcak et al., 2009), and the situations that contribute to PTSD may decrease veteran's fear of harm, habituate them to pain and violence, and allow them to acquire the ability to self-harm (Joiner, 2005). Inability to reintegrate into civilian life may lead to social alienation and a failed sense of belonging (Brenner et al., 2008). Finally, substances, such as opiates, work as a mechanism of death through overdose (Best et al., 2000). If substance use triggered or increased odds of suicide ideation, attempted suicide, or completed suicide, interventions on substance use might improve mental health, reduce suicide ideation, and help prevent or reduce suicide attempt and completion.

### 1.3. Methodological challenges

Several methodological challenges are present when studying female veterans, the first being small numbers of service women that make it difficult to accrue sufficient samples for generating meaningful results. Because of the demographic makeup of the military, unweighted rates calculated using military populations (e.g., active duty, veterans) for the denominator tend to disproportionately represent males and mask their associations with women's health indicators (Kaplan et al., 2007a,b). Additionally, veteran suicide research has traditionally used samples identified through the Department of Veterans Affairs system (VA); however, only one quarter of veterans have historically received care through these facilities (Kaplan et al., 2007a,b). Studies that consider illicit drug use also often include only small subsamples of women, limiting the analysis of associations between drug use and suicide variables (Wilcox et al., 2004). Because events of suicide attempt or death are often rare in a given study, analyses of suicidal events are constrained by a relatively small number of cases (Allen et al., 2005). Men are more likely than women to complete suicide and women tend to attempt it (Cibis et al., 2012). Thus, studies that use completed suicide as an outcome measure miss some women at risk for suicide related injury. Because female veterans and people who commit or attempt suicide are difficult to study, the influence of one behavior over another (e.g., substance abuse increasing potential

suicide) may go undetected if not targeted for research. The aim of this review is to identify whether a relationship exists between suicide and substance abuse in this population to inform future research and prevention efforts.

## 2. Methods

We searched Google Scholar, Pub Med, and PsychINFO using keywords and terms substance use, female veteran, and suicide, instructing search engines to include “and” between each term (Fig. 1). Searches resulted in 308 hits. Exclusion criteria included: failure to discuss U.S. veterans, U.S. veteran suicide, or U.S. veteran substance use, not written in English, published before 1985, or duplicating another hit. Title review eliminated 189 hits. Abstract review eliminated 54. Full reading of the remaining 65 articles eliminated 51. Bibliographic review and review of the March 2012 issue of the *American Journal of Public Health*, which was devoted to veteran suicide, produced 13 additional articles for a total of 27 articles. Final review of the 27 articles left 16 that are included in this review, and one article was added in review (Fig. 1).

## 3. Results

### 3.1. Summary of identified studies

The focus of this paper is on associations of substance use with suicide among female veterans. Here, we present information on suicide first to demonstrate how problematic suicide is in this population and to show that only few available studies of suicide among veterans have explored substance use as a related variable. We identified nine studies that analyzed completed suicide among veterans (Table 1); all included large data sets ( $n \geq 5948$ ). Three studies examined completed suicide among VA treated veterans are summarized in Table 2 ( $n \geq 10,163$ ). Additionally, five studies examined substance use and either completed or attempted suicide (Table 3); four focused on VA patients ( $n \geq 8807$ ); one focused on veterans in substance abuse treatment ( $n = 625$ ).

### 3.2. Suicide among veterans (Table 1)

Nine studies analyzed completed suicide among veterans. Three examined male and female data, one did not differentiate males and females within the study sample, three examined males only, and two focused on females only. Newest data were collected in 2008. Studies compared rates to the general population or compared combat veteran rates with non-combat veteran rates. None has examined substance use.

Rate of completed suicide was no higher among early era combat veterans when compared to noncombat veterans and the general population. Kang and Bullman (1996, 2001) compared Defense Manpower Data Center reported suicide deaths of Gulf War veterans to reported suicide deaths of noncombat military personnel ( $n = 695,516$ , women representing 7.2% of the sample;  $n = 746,291$ , women representing 13.3% of the sample, respectively) and found no differences in suicide mortality rate between Gulf War veterans and noncombat military personnel. By analyzing female veteran data reported by the Veterans Affairs beneficiary file and Social Security Administration Death Master File through 2004, Cypel and Kang (2008) also found no differences in suicide mortality rates between deployed female Vietnam veterans ( $n = 4586$ ) and not deployed female veterans ( $n = 5325$ ). Cypel and Kang (2008) did not examine variations in suicide mortality based on factors outside of women's deployment status. However, Bullman and Kang (1996) explored whether trauma affected suicide mortality among 34,534 combat-wounded, male Vietnam veterans tracked from their time of injury to 1991 (or death) and found that the Standardized Mortality Ratio (SMR) increased with combat trauma and the number of times a soldier was wounded. Similarly, Boehmer et al. (2004) examined completed suicides among 18,313 male U.S. Army Vietnam veterans followed from discharge (1965–1977) through 2000;

they found that rates of completed suicides were slightly higher for combat veterans than non-combat veterans for the first five years from discharge but not after. More recent data show a more complex picture. Although not differentiating the proportion of the sample that was female, Kang and Bullman (2008) compared the number of suicide deaths among 490,346 OIF/OEF veterans who left active duty from October 2001–December 2005 and who were followed through December 2005 to suicide deaths in the general population. They found that proportions of suicide deaths were higher among veterans with a mental disorder when compared to those without one. Taken together, it appears that the prevalences of combat veteran completed suicides are not higher than those in the general population or in noncombat veterans in the past. However, in all male samples or recent studies that did not differentiate by sex, the number of completed suicides was increased by traumatic experience and presence of a mental disorder. These studies, however, have not examined substance use status.

Of note, more recent data comparing veterans to nonveterans found a higher prevalence of completed suicide among veterans, particularly women. Kaplan et al. (2009) examined a total of 28,534 suicide decedents (women, 30% of the sample) from the 2003 to 2006 data files in the National Violent Death Reporting System (NVDRS) and found that the suicide rate among male veterans was 47% higher than the rate among nonveterans. Among female veterans, the suicide rate was nearly three times higher than that among nonveterans. Male and female veterans aged 18–34 years had the highest suicide rate. In a similar analysis of 27,391 completed suicides (2005–2008) among male veterans aged  $\geq 17$  years (24.6% active or former military) and reported by the NVDRS, Gibbons et al. (2012) found those in the youngest age group (17–24 years) were almost 4 times more likely to commit suicide than same aged men with no service. In a similar analysis of data from 2004 to 2007 female only NVDRS and American Community Survey (ACS), McFarland et al. (2010) found that, among 5948 women (aged 18–64) who committed suicide, Standardized Mortality Ratios (SMR; using female veterans as one denominator and a broader military service population as another) were greater than 1, indicating an elevated rate. The highest ratio was among veterans aged 18–34 (SMR = 3.05, 95% CI = 2.31–3.96). Age related results were similar for women with military service. Younger veterans had greater likelihood to complete suicide than older ones. Young female veterans in particular may have higher suicide mortality when compared to other women in the military and female nonveterans. It is unclear why younger age is a factor in completed suicides. Gibbons et al. (2012) suggests that it may represent a cohort effect related to particular conflicts or experiences returning from conflict. It may also be that suicide always occurs most often immediately after service (Gibbons et al., 2012). These studies, however, have not included substance use in their analyses.

In summary, data from past eras have not shown differences in completed suicide between veterans and members of the general population. However, more recent data indicated more suicide deaths among veterans than nonveterans, including among females. Studies that examined all male samples or did not differentiate by gender also found that completed suicides increased with traumatic exposure and presence of a mental health disorder. Male and female veterans aged 18–34 years had a higher suicide rate than older adults. Young female veterans in particular had higher suicide mortality when compared to women in the military and female nonveterans. These studies of female veterans did not explore factors associated with suicide beyond age and deployment status, and no studies have addressed substance use status. However, given that substance abuse among veterans is similarly associated with younger ages, combat exposure, and poor mental health (Seal et al., 2011), there is a need to explore the link between suicide and substance abuse measures.

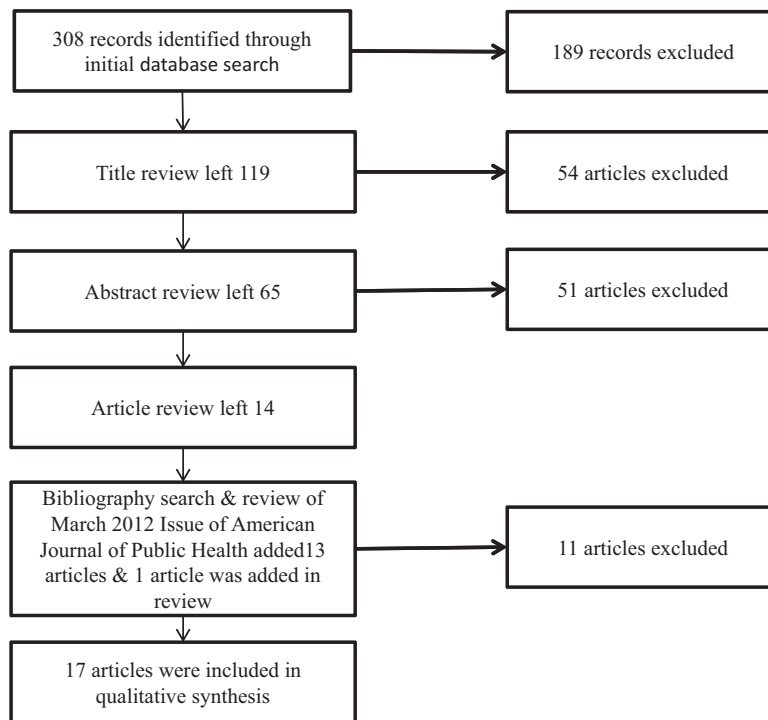


Fig. 1. Literature review flowchart.

### 3.3. Suicide among VA treated veterans (Table 2)

Of note, female VA enrollment has increased over 40% from past eras (Batuman et al., 2011). The need for research with a focus on VA treated female veterans is at an all time high. We found three studies that addressed suicide among VA treated veterans (Table 2). One did not include substance use status (McCarthy et al., 2009); one examined the prevalence of substance use in the sample (Weiner et al., 2011); and one explored drug and alcohol induced deaths (Maynard and Boyko, 2006). All data were collected during or before 2001.

Weiner et al. (2011) examined records of a total of 10,163 veterans (women, 8.8% of the sample) previously treated at the VA for a suicide attempt (1993–1998) and followed through 2002. Contrary to prior observation that men were generally more likely than women to complete suicide Cibis et al. (2012), Weiner et al. (2011) found that female veterans treated by the VA for a suicide attempt had a higher proportion of completed suicides when compared to similarly treated male veterans. It was unclear from the findings why a greater proportion of women than men completed suicide. However, more women than men in their study sample had psychoses (female 22.7% vs. male 21.0%) or depression (female 20.3% vs. male 18.3%). Completed suicide was the leading cause of death for women (25% of deaths); suicide was the second leading cause of death among men (12.7%), following heart disease. While SUD was prevalent in the sample for men (32.9% abused alcohol; 22.6% abused drugs) and women (20.7% abused alcohol; 13.5% abused drugs), relationships between substance use and suicide variables were not explored.

Additionally, suicide mortality was higher among females seen by the VA than among women in the general population. McCarthy et al. (2009) computed SMRs for those committing suicide among 4670,968 (10.1% female) former VA patients. Patients were seen by the VA in 2000 and followed to their date of death or through 2001. Rates were computed based on suicide deaths in 2001 and adjusted for age. Overall, rate of suicide deaths among VA patients (male and female) were an estimated 66% higher than suicide deaths in the

general population (SMR 1.66; 95% CI: 1.58, 1.75). Suicide deaths among VA treated males were also 66% greater than suicide deaths among males in the general population (1.66; 95% CI: 1.58, 1.74). Among females, suicide deaths were 87% higher than suicide deaths among women in the general population (1.87; 95% CI: 1.35, 2.47). Substance use was not explored.

Further, data from veterans in the VA show a high prevalence of completed suicide and alcohol/drug related deaths. Maynard and Boyko (2006) compared causes of death for Washington veterans ( $n = 62,080$ ; 4% of the sample female) by VA care status from 1998 to 2002 and found that, while suicide was the 8th cause of death for VA treated veterans, it was higher among those using the VA compared to those who did not (1.6% vs. 0.9%). Alcohol or drug induced deaths, identified with veteran death certificates, were more common among patients in VA and represented the 6th leading cause of death (5.2% vs. 1.7%). Of note, alcohol or drug induced deaths were two times more likely among female veterans using the VA when compared to female veterans not using it. Female veterans with alcohol or drug induced deaths were more likely to be young, single or divorced, and smoke cigarettes when compared to female veterans who died from other causes (e.g., cardiovascular disease).

Taken together, women who used VA services were more likely to commit suicide than women in the general population (McCarthy et al., 2009). Alcohol or drug induced deaths were twice as likely among females treated by the VA when compared to females not treated by the VA (Maynard and Boyko, 2006). However, it is unclear whether substance-related deaths were completed suicides or accidents (Maynard and Boyko, 2006). In a study of VA treated veterans with a previous suicide attempt, women also had a higher proportion of completed suicides than males (Weiner et al., 2011). In the same study, a greater proportion of women than men were also diagnosed with psychoses or depression (Weiner et al., 2011). Collectively, research could explore whether and how psychiatric status contributes to this finding (e.g., more psychopathology among women than men in VA).

**Table 1**  
Suicide among veterans from the Vietnam to modern eras.

Authors	Samples and years data collected	Study designs	Outcome measures	Key findings on suicide variables
Gibbons et al. (2012)	27,391 (24.6% active or former military) suicide deaths among men aged >17 2005–2008	Cross-sectional	Completed suicide	Estimated 24% of all suicides were by former military, risk ratio 1.29  Veterans aged 17–24 relative risk 3.84; veterans aged 25–75 1.5; veterans aged >75 1.36
McFarland et al. (2010)	5948 female suicidal descendants  2004–2007	Cross-sectional	Completed suicide	Standardized mortality ratio (SMR) military service population: aged 18–34 1.76, CI 1.32–2.27; aged 35–44 1.76, CI 1.32–2.27; aged 35–44 1.30, CI 1.00–1.66 SMR veterans aged 18–34 3.05, CI 2.31–3.96; aged 35–44 1.78, CI 1.37–2.29; aged 45–64 1.58, CI 1.27–1.95
Kaplan et al. (2009)	28,534 (30% women) suicide decedents 2003–2006	Cross-sectional	Completed suicide	Female veterans aged 18–34 had the highest rate SMR 1.15, CI 0.97–1.35
Kang and Bullman (2008)	490,346 OIF/OEF veterans October 2001–December 2005	Retrospective cohort study	Completed suicide	Active duty veterans SMR 1.33, CI 1.03–1.69 Veterans with mental disorder SMR 1.77, CI 1.01–2.87
Cypel and Kang (2008)	9911 females (46% Vietnam veterans)  Through 2004	Retrospective cohort study	Completed suicide	Vietnam veterans had lower mortality than women in the US population for all causes (SMR = 0.87, 95% CI 0.80–0.94) Adjusted suicide relative risk 0.90, CI 0.44–1.85
Boehmer et al. (2004)	18,313 Army Vietnam veterans  Discharge (1965–1977)–2000	Retrospective cohort study	Completed suicide	0–5 years from discharge, 34.5% veterans and 20.1% non-veterans committed suicide for a crude rate ratio (CRR) = 1.72, CI 0.76–3.88 >5 years from discharge, 23.7% veterans and 25.7% non-veterans (CRR 0.93, CI 0.64–1.34)
Kang and Bullman (2001)	621,902 Gulf War (7% women) and 746,291 non war veterans (13.3% women) 1991–1997	Retrospective cohort study	Completed suicide	Suicide rate for male war veterans 1.8*, non war veterans 1.9  Male adjusted rate ration (ARR) 0.92, CI 0.83–1.02 Suicide rate for female war veterans 0.8, non war veterans 0.6 Female ARR 1.29, CI 0.78–2.31
Bullman and Kang (1996)	34,534 wounded army Vietnam veterans Injury to death or 1991	Retrospective cohort study	Completed suicide	Standardized mortality ratio (SMR) = 1.12, CI 0.96–1.30 Wounded ≥2 times SMR 1.58, CI 1.06–2.26
Kang and Bullman (1996)	695,516 (7.2% women) Gulf War and 746,291 (13.3% women) non war veterans 1990–September 1993	Retrospective cohort study	Completed suicide	Hospitalized ≥2 SMR 1.73, CI 1.10–2.60 Adjusted suicide rate ratio 1.47, CI 0.63–3.43  War veterans suicide mortality rate 1.53 vs. non-war veterans 1.54 (ARR) = 0.94, CI 0.79–1.12

\* Per 10,000 person-years.

### 3.4. Suicide and substance use among female veterans (Table 3)

Five studies examined relationships between suicide variables and substance use, with four focusing on the VA populations. Two examined veterans seeking or in substance abuse treatment, and two examined veterans seeking or in mental health treatment. Two used completed suicide as their outcome measure; one used suicide attempt; one determined suicide attempt and suicidal contemplation; one used suicidal ideation. Age of data was not always reported, but the newest data were from 2007.

When substance use is implicated in increased suicide measures, it appears that multiple factors may be at work. Among 407 OIF/OEF veterans (9.06% of the sample was female) seeking mental health services through the VA in Puget Sound, Jakupcak et al. (2009) found that diagnosis with PTSD and two comorbid mental disorders, either major depressive disorder, alcohol abuse disorder, or drug abuse disorder, increased odds of suicide ideation 5.7 times (95% CI 2.09–23.85). Diagnosis with PTSD and a single comorbid condition did not increase odds. That alcohol abuse, drug abuse, or both were required to increase suicide

**Table 2**  
Suicides among veterans administration (VA) treated veterans.

Authors	Samples and years data collected	Study designs	Outcome measures	Key findings on suicide variables (females only)
Weiner et al. (2011)	10,163 (8.8% female) former VA patients 1993–2002	Retrospective cohort study	Completed suicide	Suicide was the leading cause of death for females (25%) 22.7% had some form of psychoses 20.3% had depression The most common comorbidities were alcohol abuse or disorder and drug abuse or disorder 31.8% abused alcohol or had an alcohol use disorder (32.9% males and 20.7% females) –21.8% abused drugs or had a drug use disorder (22.6% male and 13.5% female) SMR female VHA patients 1.87, CI 1.35–2.47
McCarthy et al. (2009)	4670,968 (10.1% female) former VA patients 2000–2001	Cross-sectional	Completed suicide	SMR female VHA patients aged 40–49 2.15, CI 1.25–3.29 SMR female VHA patients aged 50–59 2.36, CI 1.22–3.88
Maynard and Boyko (2006)	62,080 (4% female) Washington veterans  Using and not using VA care from 1998 to 2002	Longitudinal	Completed suicide	Suicide was the 8th cause of death for VA treated veterans, higher among those using the VA compared to those who did not (1.6% vs. 0.9%) Drug and alcohol related deaths were more common in the VA system and 6th leading cause of death (5.2% vs. 1.7%) Drug and alcohol related deaths were 2× more likely among female veterans using the VA when compared to female veterans not using it Female veterans with drug or alcohol induced deaths were more likely to be young, single or divorced, and smoke cigarettes when compared to those who died from other causes (e.g., cardiovascular disease)

ideation suggests that these interact with PTSD to endanger veterans.

Prolonged alcohol and cocaine use also appears to increase odds of suicide attempts among veterans using VA services. Ilgen et al. (2007) examined a national sample of 8807 (4% of the sample was female) veterans who sought treatment for a SUD through the VA at intake and an average of 13 months after and found that 4.0% reported a suicide attempt within 30 days of follow-up. Three indices increased odds of suicide attempt: severe suicidal or psychiatric symptoms, an increased number of days of alcohol problems, and longer years of cocaine use. The effects of the three indices were found to be additive. Greater engagement in substance abuse treatment decreased odds of suicide attempt from 10% to 5%, suggesting the importance of treating substance use problems. Involvement with the criminal justice system also decreased odds of suicide attempt, which may reflect receipt of substance use treatment while incarcerated. Results suggest that current models used to predict suicide behavior may be strengthened by including a broader array of factors, such as past suicide attempt and substance use, and that substance use treatment might reduce suicidality (Ilgen et al., 2007).

VA treated veterans with a SUD had a higher suicide mortality rate than those without a disorder. Zivin et al. (2007) examined completed suicides among 807,694 veterans (2.7% females in the sample) treated by the VA for depression between April 1, 1999–September 30, 2004 and found a high rate of completed suicide (88.25 per 100,000 person-years vs. 13.50 per 100,000 person-years in the general population). The suicide rate among veterans treated for depression with a comorbid SUD rose to 119.73 per 100,000 person-years, although veterans treated for comorbid PTSD and depression had a reduced rate (Hazard Ratio 0.77, 95% CI 0.68, 0.87). Young veterans were more likely than older ones to commit suicide, and men more likely than women. The suicide relative risk ratio among male to female veterans was 3:1, which was smaller than the 4:1 ratio found for men to women in the general

population. The lower ratio suggests a closer suicide gap between men and women in the studied sample and that completed suicide may disproportionately affect women in the VA treated veteran population, which may relate to poor mental health or substance abuse among treated female veterans (Zivin et al., 2007).

Among VA treated veterans, another study showed that psychiatric diagnosis, particularly SUD, is associated with the highest hazard ratio for completed suicide among women. Ilgen et al. (2010b) examined data for 3291,891 veterans treated by the VA and followed from FY2000–FY2007 or until death and found that 46.8% of those who had committed suicide had a psychiatric condition. The second most common condition was SUD (21.3%), following depression (31.2%). While completed suicide hazard ratios were higher for males compared to females (hazard ratios for females 0.28, CI 0.25–0.32), women with any current mental disorder had increased hazard ratios for completed suicide when compared to men. For men, the highest hazard ratio for completed suicide was observed with bipolar disorder. For women, the highest hazard ratio for completed suicide was observed with a SUD, suggesting the need for research to elucidate the effects of SUD on suicide for women.

One study examined suicide ideation and attempted suicide among veterans in substance abuse treatment. In a study of 315 male and 310 female homeless veterans in treatment for substance abuse, Benda (2005) found that previous suicidal ideation was higher in females (48.7%) than males (44.4%), and so was a past suicide attempt (36.5% vs. 26.7%, respectively). Sexual or physical abuse in childhood, current sexual abuse, family problems, partner problems, depression, and fearfulness predicted suicidal ideation and attempt among women, while self-esteem and social support decreased odds of suicidal ideation and attempt (Benda, 2005).

In summary, PTSD increased suicide risk among male and female VA treated veterans when it co-occurred with substance abuse and another mental disorder, either a different kind of substance abuse or major depressive disorder. Women with a current SUD had a

**Table 3**  
Suicide and substance use among veterans in the modern era.

Authors	Samples and years data collected	Study designs	Outcome measure	Key findings on suicide and substance use
Ilgen et al. (2010b)	3291,891 (10% female) former VA patients Treated 1999–1998 and followed 2000–2007	Prospective cohort study	Completed suicide	46.8% of completed suicides had a psychiatric condition The most common was depression (31.2%) followed by a substance use disorder (21.3%) Women with any substance abuse or dependence were at increased risk of suicide when compared to men Women with the greatest risk were those with a substance use disorder In men, risk was greatest for those with bipolar disorder, followed by depression, and substance use disorder
Jakupcak et al. (2009)	435 Operation Enduring Freedom/Operation Iraqi Freedom Veterans referred to VA mental health services from 2004 to 2007	Cross-sectional	Suicidal ideation	Veterans with PTSD + 2 comorbidities that included either major depressive disorder, alcohol abuse or drug abuse were 5.7 times more likely to endorse suicidal ideation than veterans with PTSD only Veterans with PTSD and one comorbidity were not more likely to endorse suicidal ideation
Ilgen et al. (2007)	8807 (4% women) veterans seeking VA treatment for substance use disorders 49% in treatment for alcohol, 26% for combined alcohol and drug use, 10% cocaine, 6% poly-drug use, 3% heroin, and 2% marijuana Years data collected not provided	Retrospective cohort	Suicide attempt	4% reported a suicide attempt within 30 days of follow-up  Three baseline indices were unique risks for a suicide attempt: severity of suicidal/psychiatric symptoms, number of days of alcohol problems, and age adjusted years of cocaine use  Only involvement in the criminal justice system was protective Substance use treatment did not mediate the effect of risk factors on suicide attempt, but the final model was additive, indicating increased risk with each factor Greater engagement in treatment cut suicide risk from 10% to 5%
Zivin et al. (2007)	1683 veterans (2.7% women) treated by the VA for depression 1999–2004	Longitudinal	Completed suicide	Veterans with a substance abuse diagnosis had a higher rate of suicide than those without  Ratio among male to female veterans was 3:1 vs. 4:1 in the general population
Benda (2005)	315 homeless male and 310 homeless female veterans In treatment for substance abuse	Prospective cohort study	Suicide ideation and attempt	44.4% of males contemplated suicide and 26.7% attempted it 48.7% of females contemplated suicide and 36.5% attempted it Sexual or physical abuse in childhood, current sexual abuse, family problems, partner problems, depression, and fearfulness predicted suicidal measures among women Self-esteem and social support were protective

higher hazard ratio for completed suicide compared to men with a current SUD (Ilgen et al., 2010b). Of all mental disorders examined, women with a SUD had the highest hazard ratio for completed suicide (Ilgen et al., 2010b). Veterans with comorbid depression and a SUD also had a higher suicide mortality rate than veterans with depression and no SUD (Zivin et al., 2007). Collectively, substance abuse or dependence may increase odds of completed suicide in women and that comorbid depression and SUD may interact to increase odds of suicide among female veterans. Previous suicidal ideation was also higher in female veterans in treatment for substance abuse than in males, and so was a past suicide attempt (Benda, 2005). On the other hand, engagement in substance abuse treatment can decrease odds of suicide attempt among VA treated veterans (Ilgen et al., 2007).

#### 4. Discussion

Substance use problems and suicide appear to disproportionately affect female veterans. Data showed high levels of problematic

substance use by female veterans using the VA (Bradley et al., 2003; Davis et al., 2003). Military women also had increased odds of initiating problem drinking and more often engaged in unsafe drinking and illicit or nonmedical drug use compared to military men (Jacobson et al., 2008; Lande et al., 2007; Bray and Hourani, 2007). Data also showed a disproportionately high prevalence of suicide deaths among female veterans, with two studies finding a female veteran suicide rate three times higher than that of women in the general population (Kaplan et al., 2009; McFarland et al., 2010). Additionally, gender specific comparison found women using the VA completed suicide in disproportionately high numbers when compared to men using the VA (Zivin et al., 2007). Among VA treated veterans, substance use was implicated in increased suicide ideation, attempt, or completion (Zivin et al., 2007; Ilgen et al., 2007; Jakupcak et al., 2009), and completed suicide hazard ratios for females were highest for those with a SUD (Ilgen et al., 2010b). Veteran substance abuse or disorder and completed suicide share common correlates, including younger age, combat exposure/deployment, and poor mental health. How each correlate relates to female veterans is discussed below.

Poor mental health positively correlates with suicide and substance use, and diagnosis with either depression or PTSD and a comorbid SUD increased the likelihood of completed suicide and suicidal ideation among VA treated veterans (Zivin et al., 2007; Jakupcak et al., 2009). While poor mental health and a SUD increased suicide measures for males and females, female veterans appear particularly vulnerable to adverse effects. Data from the 2004–2006 NSDUH found that female veterans were twice as likely as male veterans to experience past-year severe psychological distress (14.5% vs. 6.5%; SAMHSA, 2007b), and Weiner et al. (2011) found that the association between a psychiatric diagnosis and suicide was greater for female than male veterans. Female veterans in the VA SUD outpatient treatment setting also had high prevalences of comorbid mental disorders, with 47.6% also having PTSD, 38.7% serious mental illness, and 31.9% major depressive disorder (Gifford et al., 2011). In addition, females who served in OIF/OEF and used large quantities of alcohol and drugs screened positive for PTSD more than those not using substances, and comparison of women screening positive versus negative for PTSD found only alcohol use predicting the PTSD status (Nunnink et al., 2010). When examining relations among SUD, poor mental health, and suicide, it is worth noting that SUD may be uniquely important. Jakupcak et al. (2009) found that, while PTSD and one comorbid diagnosis (depression, alcohol abuse, or drug abuse) did not increase suicide ideation among VA treated veterans, PTSD and diagnosis with two did. Zivin et al. (2007) also found an increased suicide rate among VA treated veterans with comorbid depression and SUD but a decreased rate among VA treated veterans with comorbid PTSD and depression. Among female veterans, clustering of substance use and poor mental health may indicate a severe pattern of psychopathology, as substance abuse could intensify existing mental disorders (Leeies et al., 2010).

Combat exposure also increased the likelihood for suicide and substance use among veterans. This may relate to poor mental health, as exposure to violence can result in conditions, such as PTSD. Past violence increased the likelihood of suicide ideation and attempt among individuals seeking SUD treatment when controlling for demographic factors and depressive symptoms in a national sample (Ilgen et al., 2010a). More extreme violence increased the likelihood of multiple suicide attempts (Ilgen et al., 2010a). Data predating OIF/OEF suggests that female veterans are more likely than male veterans to meet PTSD criteria after traumatic exposure (Tolin and Foa, 2006). Direct combat exposure is increasing for women due to the changing nature of warfare (Hoge et al., 2007), and the recent lift on the ban restricting women from some combat roles, including positions in the infantry, armor, and special operations (Rand, 2013), suggests that this trend will continue. However, even women not directly in combat may experience associated trauma through support activities, such as handling human remains (Hoge et al., 2007). Repeated traumatic exposure increases the likelihood of PTSD (Cloitre et al., 2009), and Sadler found that 54% of 520 female veterans reported a history of physical or sexual violence before service. Sexual harassment and abuse also may increase odds of PTSD, depression, or SUD (Kimerling et al., 2010; Booth et al., 2011), and service women are more often subjected to sexual misconduct than service men (Street et al., 2009). Of 3946 (59% female) veterans, Gradus et al. (2008) found women who experienced sexual harassment had increased odds of harmful drinking, men did not, and the relationship was accounted for by depressive symptoms. It appears that a history of violence and co-occurring combat and sexual traumas may have cumulative psychological effects (Street et al., 2009). Women specific deployment stressors also affect mental health. For example, among 495 (25% female) Gulf War veterans, Vogt et al. (2005) found that concerns about family/relationship disruptions and lack of social support during deployment affected women's post deployment

mental health more than men's (Vogt et al., 2005). OIF/OEF data also showed that deployed women more often developed major depression and SUD than deployed men (Shen et al., 2012). Upon return, difficulties readjusting to previous familial and social roles, public and private perceptions of what it means to be a female veteran, and inability to access health care can exacerbate problems (Street et al., 2009). Female military personnel and veterans face multiple stressors that can impact mental health.

Younger age also associated with suicide and substance use. This may represent a cohort effect, relating to particular conflicts or time-specific experiences that occur when returning from conflicts (Gibbons et al., 2012). It might also be that veteran suicide is time sensitive, most often occurring immediately after leaving the service (Gibbons et al., 2012). Alternatively, it could be that younger individuals are more likely than older ones to engage in self-injury (Serras et al., 2010). Bakst et al. (2010) analyzed data for 529 individuals with psychotic illness to develop a suicide risk index and also found that younger age increased likelihood of suicide attempt, and so did lifetime substance abuse. Historical findings also suggest that, compared to older individuals who completed suicide, younger individuals who completed suicide were more likely to have used drugs (Rich et al., 1986). While young age positively associates with suicide and substance use among female veterans, the nature of the relationship is unclear.

The identified associations among substance use, poor mental health, and suicide relate have important clinical applications. A challenge in suicide prevention is identifying subgroups of individuals to benefit from suicide-related intervention (Ilgen et al., 2010a,b). Findings suggest that female veterans with SUD and comorbid depression or PTSD are such a subgroup. Female veterans in poor mental health are likely to endorse multiple health problems, suggesting a need for primary care strategies tailored toward them (Dobie et al., 2004). Knowledge of suicide risk may also be low among SUD treatment providers (Ilgen et al., 2010b), who should be made aware of the potential for suicide behaviors among female veterans seeking assistance (Ilgen et al., 2007). The high prevalence of comorbid SUD and other mental disorders indicates a need for evidence-based treatment programs to address multiple disorders, something largely lacking from current VA services (Seal et al., 2011). Additionally, SUD often goes undiagnosed among Iraq and Afghanistan veterans (Seal et al., 2011), which may be especially true of women who were historically often missed by traditional screening measures (Davis et al., 2003). Better screening is needed to identify those needing services (Seal et al., 2011), as engagement in substance abuse treatment may decrease odds of suicide attempt (Ilgen et al., 2007).

Current findings suggest avenues for future research. It is likely that multiple factors are at work, and studies must explore how substance use, poor mental health, and suicidal behaviors interact in this vulnerable population. Some female veterans may self-medicate with substances to relieve psychological symptoms (Leeies et al., 2010). However, female veterans seeking VA assistance for psychological problems are more vulnerable to drug abuse due to gender differences in VA prescribing practices. For example, females presenting to the VA for PTSD received benzodiazepine 38.3% of the time, while similar males received them only 29.8% (Bernardy et al., 2012). Benzodiazepines are contraindicated in PTSD cases, have high potential for dependence (Bernardy et al., 2012), and are implicated in increased completed suicides among veterans (Pfeiffer et al., 2009). Similarly, female veterans with PTSD may be more susceptible to self-harm because of past exposure to pain and violence (Joiner, 2005). With each of these, substance use might increase impulsivity and trigger suicidal action (Braquehais et al., 2010), and thus offer a unique opportunity to intervene. Longitudinal data are needed to elucidate the temporal associations (i.e., SUD leading to mental disorder or mental disorder



leading to SUD) among female veterans to inform intervention efforts. Additionally, substance use studies should include suicide variables and vice versa. Because women are more likely to attempt suicide and men complete it (Cibis et al., 2012), studies with a special focus on suicide attempt may be warranted to help identify more female veterans in need of targeted intervention efforts. As most studies that examined suicide and substance use had female samples at  $\leq 10\%$ , this may be especially warranted. The proportion of women with military service is increasing, as are their mental health needs. New research must address the needs of this population.

While the overall proportion of female veterans in studies that examined suicide and substance use were small, results were suggestive. There is a clear association between suicide and substance use among female veterans, particularly when comorbid mental illness is included in analyses. How this relationship works is unclear and research is needed to explore pathways and potential interventions. Because women traditionally made up only a small proportion of veterans, female veteran mental health needs have often gone overlooked (Goldzweig et al., 2006). Women are the fastest growing cohort in the veteran community, and the VA is committed to identifying and serving female veteran's unique health care needs (Friedman et al., 2011). Overall, findings highlight the importance of assessing suicidal measures in female veterans with complex psychiatric profiles, particularly those who misuse substances.

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### Contributors

Author Chapman conducted the literature search. Authors Chapman and Wu wrote the manuscript.

### Conflict of interest statement

Authors declare they have no conflicts of interest.

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