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The Epidemiology of Substance Use Disorders in US Veterans: A Systematic Review and Analysis of Assessment Methods

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Abstract

Background—Substance use disorders (SUDs), which encompass alcohol and drug use disorders (AUDs, DUDs), constitute a major public health challenge among US veterans. SUDs are among the most common and costly of all health conditions among veterans.

Objectives—This study sought to examine the epidemiology of SUDs among US veterans, compare the prevalence of SUDs in studies using diagnostic and administrative criteria assessment methods, and summarize trends in the prevalence of SUDs reported in studies sampling US veterans over time.

Methods—Comprehensive electronic database searches were conducted. A total of 3,490 studies were identified. We analyzed studies sampling US veterans and reporting prevalence, distribution, and examining AUDs and DUDs.

Results—Of the studies identified, 72 met inclusion criteria. The studies were published between 1995 and 2013. Studies using diagnostic criteria reported higher prevalence of AUDs (32% vs. 10%) and DUDs (20% vs. 5%) than administrative criteria, respectively. Regardless of assessment

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Declaration of Interest

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method, both the lifetime and past year prevalence of AUDs in studies sampling US veterans has declined gradually over time.

Conclusion—The prevalence of SUDs reported in studies sampling US veterans are affected by assessment method. Given the significant public health problems of SUDs among US veterans, improved guidelines for clinical screening using validated diagnostic criteria to assess AUDs and DUDs in US veteran populations are needed.

Scientific Significance—These findings may inform VA and other healthcare systems in prevention, diagnosis, and intervention for SUDs among US veterans.

INTRODUCTION

Substance use disorders (SUDs), which encompass alcohol and drug use disorders (AUDs, DUDs) constitute a major public health challenge among US veterans.[1,2] SUDs are among the most common and costly of all health conditions among veterans.[3,4] As one of the worlds' largest providers of mental health care, the US Department of Veterans Affairs (VA) treats over 1.1 million patients diagnosed with psychiatric disorders or SUDs annually.[5] Over one-third of VA inpatients screen positive for psychiatric disorders or SUDs.[3,6] In 2007 alone, over 375,000 patients in the VA system were diagnosed with an SUD.[7] The number of veterans treated for an SUD in an outpatient setting increased by 52.7% between 2005 and 2012, and there was a rise in the number of veterans diagnosed with opioid dependence from 2003 to 2005.[8]

Of late, there is considerable concern that veterans from more recent conflicts (ie, Operation Iraqi Freedom [OIF] and Operation Enduring Freedom [OEF]), particularly those who have psychiatric conditions including post-traumatic stress disorder (PTSD), are disproportionally affected by SUDs.[2] Notably, increasing numbers of deployments to Iraq and Afghanistan, in addition to combat experience, have been associated with higher rates of both alcohol and other substance abuse among OIF/OEF veterans.[9,10]

Analyzes of VA administrative data and clinical diagnostic methods have been used to examine the occurrence of SUDs among US veterans. Given the various screening instruments that have been used to examine the prevalence of SUDs reported in studies sampling US veterans, it is important to systematically review the available research to analyze and understand whether different assessment methods produce different SUD estimates. Two systematic reviews have recently been published that summarize the epidemiology of SUDs in US veterans.[11,12] One study provided a review of literature examining substance misuse, abuse, and dependence among women veterans, and the other study specifically examined whether alcohol or other SUDs were more common in Gulf War, Afghanistan, and Iraq War veterans compared to non-deployed military groups (eg, reserves). As noted in one of the previous systematic reviews,[11] most studies rely on VA medical records data, and there is evidence that theses methods underestimate the true prevalence. Therefore, this study complements the other systematic reviews by providing a direct comparison of SUD prevalence using diagnostic assessment and administrative methods, and also evaluates trends in SUD prevalence over time. Although the Institute of Medicine recently published a comprehensive review of prevention, screening, diagnosis,

and treatment modalities for SUDs among active members of the US Armed Forces,[13] to our knowledge, no study has systematically reviewed the published epidemiology of SUDs using different assessments (ie, diagnostic or administrative methods) among US veterans.

The purpose of this study was to conduct a systematic review to compare and contrast the prevalence of SUDs reported in studies sampling US veterans using either clinical diagnostic or administrative assessment; in addition, this study aimed to summarize the trend in the prevalence of SUDs reported in studies sampling US veterans in the past two decades. The findings of this review may help to achieve more effective prevention and treatment efforts by shaping the content of targeted screening, and informing prioritization of resources to identify and reach those US veterans most affected by SUDs.

METHODS

Search Strategy

Studies were retrieved from several electronic databases (PsycINFO®, The Cochrane Library, CINAHL, Web of Science™, and MEDLINE/PubMed) using a Boolean search strategy.[14] The searches consisted of the following broad terms: (i) veterans, and (ii) substance use disorders. Search terms were modified using individual database search guidelines, as needed, for each electronic database searched. For example, the search terms used in the PubMed search were as follows: veteran* AND substance use OR substance-related disorders [MeSH] OR (substance related AND disorder*) OR substance-related disorders OR addict* OR drug dependence OR drug dependence [MeSH] OR drug addiction [MeSH] OR substance use disorder [MeSH] OR substance dependence OR drug use OR substance abuse [MeSH] OR drug abuse [MeSH] OR substance addiction [MeSH] OR drug use disorder [MeSH] OR binge drinking OR ((binge AND (alcohol OR ethanol)) OR alcohol abuse OR alcoholic OR alcohol abuse [MeSH] OR alcoholism OR alcoholism [MeSH] OR alcohol use disorder* OR alcohol-related disorders [MeSH] OR alcoholic intoxication [MeSH] OR intoxicat*. As a second step, reference sections of relevant reviews (including published reviews obtained through the electronic database search) and included studies were reviewed by hand.

Inclusion Criteria

Studies were included in this systematic review if they: (i) sampled US veterans or reported on US veterans as a separate analytic group; (ii) assessed AUDs or DUDs using established DSM or World Health Organization International Classification of Diseases (ICD) diagnostic criteria; (iii) reported on the prevalence, distribution, or correlate(s) of SUD(s) in a US veterans sample; and were published in English. Diagnostic assessment defined AUDs or DUDs using validated diagnostic instruments, including the DSM and others described below, while administrative assessment defined AUDs or DUDs using ICD-9 codes (eg, 305.00–305.03 for alcohol abuse and 305.20–305.93 for drug abuse). In order to minimize misclassification of SUDs and other measurement errors, we restricted our review to studies that utilized previously validated diagnostic instruments, such as the Diagnostic Interview Schedule (DIS),[15] the Structured Clinical Interview for DSM-IV (SCID),[16] the Composite International Diagnostic Interview (CIDI-2),[17] the Psychiatric Research Interview for

Substance and Mental Disorders (PRISM),[18] and the Alcohol Use Disorder and Associated Disabilities Interview Schedule-IV (AUDADIS-IV) (19) or operationalize diagnostic criteria.

Exclusion Criteria

Due to our intention to summarize evidence regarding the prevalence of SUD diagnoses in studies sampling US veterans, we excluded studies that only used screening (rather than diagnostic) tools to identify problematic substance use behaviors (eg, the Alcohol Use Disorder Identification Test [AUDIT], the CAGE substance abuse screening tool, and the Drug Abuse Screening Tool [DAST]). Consistent with the selection criteria and overall review objectives, we excluded studies that sampled veterans entirely from substance abuse treatment programs and studies that only reported on substance use patterns or frequency (rather than disorders), and did not assess SUDs using established measures (as described above).

We further excluded studies published prior to 1987, as this year coincides with the publication and adoption of DSM-IIIR, in which significant changes were made to the classification of alcohol and substance abuse/dependence. Studies published during or after 1987 but that used DSM-III or earlier criteria were also excluded. Although DSM-V aligns nicotine dependence with other SUDs, we did not include studies exclusively assessing tobacco use disorders to be consistent with most previously published literature in this area.

Finally, we excluded case reports, case series, editorials, commentaries, and previously published narrative reviews. Given that the focus of this review was on the epidemiology of SUDs and not on substance abuse treatment interventions per se, we only included randomized controlled trials if pretreatment baseline data on the distribution or correlates of SUDs were reported. Although “grey literature,” including reports from the Substance Abuse and Mental Health Services Administration (SAMHSA), the Department of Defense, the VA, and other governmental organizations were reviewed and informed the objectives and context of the systematic review, we chose to focus our study on the synthesis of results published in the scientific, peer-reviewed literature.

Screening and Extraction Procedures

The primary author (C.W.L.) screened the titles and abstracts of each record and excluded studies that did not meet the inclusion criteria. Full-text articles were retrieved for all studies for which eligibility was unclear. Full-text versions of the remaining articles were then screened independently by two authors (C.W.L. and B.D.L.M.). Based upon the inclusion criteria, studies were categorized as “potentially relevant” or “irrelevant” by each author. Classifications were then compared for each record and any discrepancies were discussed until a consensus was reached.

Studies that fulfilled the above-mentioned selection criteria and were available and published by January 1st, 2014 were included. Comprehensive electronic searches identified 3,490 unique and potentially relevant reports. In a first stage of screening, 3,228 were excluded on the basis of their titles and abstracts because they did not meet inclusion criteria. Of the 262 full-text articles screened for eligibility, 190 were excluded in the second

stage of screening because they: (i) did not provide SUD measures using established DSM or ICD diagnostic criteria, (ii) only sampled participants with AUD or SUD (ie, a treatment sample), or (iii) used DSM-III diagnostic criteria (see details in Fig. 1). We included 72 studies in the final analysis. We based our synthesis on all 72 eligible studies.

Data extraction was conducted to obtain study information, including sample characteristics (eg, gender, marital status, ethnicity) and primary results. First, studies were stratified into two categories: (i) studies that used diagnostic criteria; and (ii) analyses using administrative records that defined SUDs using ICD-9 codes. Second, the prevalence of AUDs and DUDs in studies sampling US veterans were pooled from each category of studies, and were analyzed separately. We also extracted and pooled the reported prevalence of PTSD among the subset of studies that reported this information. Third, we analyzed the temporal trends of AUDs and DUDs prevalence from each category by plotting the prevalence estimates from each study by publication year. Least squares regressions were weighted by sample size and the trend line for each outcome for each study category. Finally, we conducted three sensitivity analyses, the first to examine the effect of different timeframes (ie, lifetime vs. past-year SUD) on observed trends in AUD and DUD prevalence over time. In a second sub-analysis, we also determined whether the year of earliest data collection (rather than publication year) affected the results. Finally, given that some studies focused on populations of specific clinical interest (eg, homeless veterans, HIV-infected veterans), we conducted a third sensitivity analysis, excluding studies with samples of veterans who may be at particularly high risk for SUDs. Specifically, we included in this sub-analysis only those studies that were representative (eg, relied on a random sampling frame), or derived samples based on access to VA health services, wartime era, or service period alone.

RESULTS

Overview

Across both types of study designs, the 72 eligible studies were published between 1995 and 2013. The earliest date of data collection was 1987. Of the 43 studies that reported on age distributions, the mean age was 52 years. A total of 40 studies reported the prevalence of PTSD. The 72 studies sampled a total of 18,466,328 US veterans, and of these participants, 91% were men.[19–54]

Prevalence of SUDs in Studies Sampling US Veterans Using Diagnostic Criteria

The 37 studies employing diagnostic criteria were published between 1995 and 2013. The earliest date of data collection was 1987. The 37 studies sampled a total of 123,885 US veterans.[20–23,25–56] Of the 123,885 participants sampled, 97% were men, with a mean age of 46 years. Of the 36 studies that differentiated between AUDs and DUDs, 32% of participants with diagnosed with an AUD, and 20% with diagnosed with a DUD. Of the 22 studies that reported on PTSD, the pooled prevalence was 19%. Table 1 provides additional sample details for the 37 studies using diagnostic criteria.

Several eligible studies used data from the NSDUH to examine the prevalence of SUDs in probability-based samples of veterans. For example, a study conducted by Golub et al.[32]

used data from the 2004 to 2010 NSDUH cycles, and found that even though 75% of veterans reported having consumed alcohol in the past month, 18% of the sample met the DSM-IV criteria for an AUD.

Prevalence of SUDs in Studies Sampling US Veterans Using Administrative Criteria

Among the 72 eligible studies, 35 studies used administrative data and sampled a total of 18,342,443 US veterans.[5,57–90] Table 2 provides sample details for the 35 studies that used VA administrative data (SUD ICD-9 diagnostic codes) to examine the prevalence of SUDs reported in studies sampling US veterans accessing VA care. These studies were published between 1995 and 2013. The earliest date of data collection was 1993. Of these participants, 91% were men, with a mean of 52 years of age. Overall the pooled prevalence of SUDs reported in studies sampling US veterans was 11%, and of the studies differentiating between AUDs and DUDs, the prevalence was 10% and 5%, respectively. In one notable nationwide study by Seal et al.,[84] the prevalence of current AUD diagnoses in OEF/OIF veterans in VA healthcare was observed to be 11% for men and 5% for women. Of the 18 studies that reported on PTSD, the pooled prevalence was 10%.

Comparing SUDs in Studies Using Diagnostic and Administrative Criteria

The findings show that the prevalence of SUDs reported in studies sampling US veterans between the two groups of studies are different: studies using diagnostic criteria reported higher rates of SUDs overall (15% vs. 11%), as well as among studies that differentiated between AUDs (32% vs. 10%) and DUDs (20% vs. 5%) specifically. Of note, the samples were predominantly white (72%), yet studies using administrative data tended to have a higher proportion of African Americans than studies using clinical diagnostic criteria (28% vs. 18%), with a similar proportion of Hispanics (6% vs. 8%).

Trend of SUDs in Studies Using Diagnostic and Administrative Criteria

Studies using diagnostic and administrative criteria have both shown a gradual decline in the reported prevalence of AUDs in sampled US veterans over the past 20 years (Figs. 1 and 2). A similar gradual decline was observed when the analyses were stratified by timeframe (lifetime and past year, Figs. 1 and 2, respectively). Notably, from 1994 to 2014, there was wide variability in the estimates of lifetime AUDs prevalence in studies using diagnostic criteria (Fig. 1, Panel A). We observed less variability in the prevalence of lifetime and past year AUDs in studies using administrative records over the past two decades (Figs. 1 and 2, Panel B).

Studies using diagnostic criteria have shown a gradual decline in the reported prevalence of DUDs in studies sampling US veterans over the past 20 years (Fig. 3, Panel A). In contrast, DUD prevalence has been approximately stable in studies using administrative criteria (Fig. 3, Panel B). Similar results were observed when the analyses were stratified by lifetime and past year timeframes (see Figs. 3 and 4, respectively).

We conducted a second sub-analysis in which publication year was replaced by the earliest date of data collection in the weighted regression analysis. Of the 43 studies that reported dates of data collection for AUD prevalence, we observed a greater representation of

administrative studies in more recent years (see Fig. 5). A similar pattern was observed among the 32 studies that reported the dates of data collection for DUD prevalence (see Fig. 6). As shown in Figures 5 and 6, the observed difference in AUD and DUD prevalence reported in diagnostic versus administrative studies has diminished in more recent years of data collection.

We conducted a third sub-analysis that included only studies that were representative (eg, relied on a random sampling frame) or consisted of general VA samples. Of the 23 studies included in the analysis, studies using diagnostic and administrative criteria have both shown a gradual decline in the reported prevalence of AUDs in sampled US veterans over the past 20 years (Fig. 7). In contrast, DUD prevalence has been approximately stable in these studies using both diagnostic and administrative criteria (Fig. 8).

DISCUSSION

Summary

The results of this systematic review suggest that the prevalence of AUDs and DUDs reported in studies sampling US veterans using diagnostic criteria are generally higher than studies using administrative records abstraction, although differences have diminished over time. It is important to note that diagnoses of AUDs using either assessment method have shown a gradual decline in the past 20 years, although the decline is greater in studies using diagnostic criteria than those using administrative criteria. A similar trend was also observed in the sub-analysis that only included the studies that were representative or were general VA samples. Among studies assessing DUDs, those using diagnostic criteria have shown a gradual decrease in the prevalence of DUDs. Notably, this decline in DUD prevalence was not observed in the sub-analysis that only included the studies that were representative or had general VA samples. Studies using administrative criteria suggest that the prevalence of DUDs has been largely stable. Research to further investigate DUD prevalence by assessment method, including for example studies specifying the type of drug abuse among US veterans with DUDs, may be informative.

The decline of reported AUDs in studies sampling US veterans may be attributed to targeted interventions and increased awareness of alcohol use among the veteran populations. However, relatively high rates of AUDs and DUDs among studies sampling US veterans remain a significant public health concern. The observed prevalence of AUD and DUD diagnoses in the sample of veterans were higher than civilians. Notably, rates of AUD diagnoses (10.5% for men and 4.5% for women) for OEF/OIF veterans reported by Seal et al.,[84] were higher than civilian AUD prevalence, which generally range from 3.1% to 8.5%.[91] In the study, 4.5% of the veterans received a DUD diagnosis, which is higher than DUD prevalence estimates among civilians, which have been reported to be approximately, 1.4–2.0%.[92–94] Overall, the results of this systematic review are broadly consistent with the results of a DoD and VA survey of returning veterans from the current conflicts (ie, OEF/OIF/OND), suggesting that SUDs continue to affect large numbers of veterans.[7]

High rates of PTSD comorbidity with SUDs, particularly among veterans with other mental health problems, have also been reported.[62,83] The average prevalence of post-traumatic

stress disorder (PTSD) was found to be different across the two types of assessments (19% among studies using diagnostic criteria and 10% among studies using administrative criteria). A recent study found that, of those with co-occurring AUD and DUD, 75% received a comorbid PTSD diagnosis.[84] Several studies have hypothesized that self-medication of mental health symptoms, such as PTSD, may drive comorbidity with SUDs.[95,96] With an increasing prevalence of PTSD among OEF/OIF veterans who are mostly under age 45, the continued development of interventions to target this population to address co-morbid psychiatric and SUDs are needed. Further research is needed to analyze the temporal trends of PTSD prevalence in studies sampling US veterans, and within sub-groups of particularly high-risk veterans, to identify the need for and potential benefits of targeted interventions addressing SUD and PTSD comorbidity. Some studies have shown that interventions to reduce stigma, encourage utilization of confidential treatment programs, and eliminate other social and systematic barriers to care may be effective at decreasing the likelihood of chronic SUDs, relapse, or initiation among veterans with mental health problems, including PTSD.[97,98] Dual-track PTSD-SUD treatment and coordinated SUD and PTSD care may help reduce morbidity and mortality among those with comorbid SUDs and PTSD.[62]

Study Implications

It has been estimated that only one-third of all eligible veterans utilize Department of Human Assistance (DHA) health care facilities and mental health services,[99] and many of those in need of mental health services seek non-VA primary care clinics.[100] Therefore, continued improvements in access to care and increased VA healthcare service utilization, particularly for SUDs, are needed. There is also a strong need to increase awareness of veterans' issues regarding mental health and substance use disorders in primary health care settings, particularly in light of the many challenges that may arise when veterans reintegrate into families. Several interventions hold promise. For example, the American Academy of Family Physicians and other primary care physician organizations developed the patient-centered medical home (PCMH) as a comprehensive model of care for children, youth, and adults, with a focus on family centered care to promote the overall health and care of the patient.[101] This model has been adopted by the VA and tailored for veterans, named the Patient Aligned Care Teams (PACT). This approach emphasizes team-based care, offers multiple ways to access health care, and seeks to meet individualized health goals. In addition, the Substance Use Disorder QUERI Strategic Plan works in partnership with the VA Office of Mental Health Services (OMHS), with the goal of improving accessibility, quality, effectiveness, and efficiency of SUD specialty treatment, treatment within VA medical settings, and improve integrated treatment of SUD and co-morbidities.[102] Research is needed to identify whether such programs result in improved recognition and treatment of US veterans with alcohol and drug use disorders.

These findings may be helpful in designing programs to meet the psychiatric needs of veterans, including those from different war eras. The data suggest that there is a need to expand the use of SUD screening tools, in addition to the screening and social media campaigns that have been recently implemented by the US Armed Forces to address high-risk drinking and reduce alcohol-related problems among military personnel.[84] Currently,

the VA does not recommend universal screening for non-alcohol substance use disorders, given the relatively lower rate of DUD diagnoses among veterans accessing VA health care compared to AUD.[7] This likely reflects the unclear value of screening and brief interventions for DUD in general healthcare settings.[103–105] However, our findings suggest that the true prevalence of DUDs may be higher than that indicated by administrative data, particularly among veterans with co-morbid mental health problems. Notably, veterans with dual diagnoses of SUDs and mental disorders such as PTSD often have more severe symptoms and poorer treatment outcomes than individuals with single, non-substance use mental health disorders.[106–109] Furthermore, previous studies have shown that there are unmet SUDs treatment needs among veterans.[32,110] Therefore, research on developing more effective strategies to identify and address SUDs in veterans, particularly for those with previous mental health diagnoses, is needed. Finally, further research is needed to evaluate and improve the reliability of clinical diagnoses for DUDs against “gold standard” diagnostic assessments among US veterans.

Given that a considerable proportion of US veterans do not use VA health care,[111] these findings also have implications for non-VA health care providers. Clinicians treating veterans in non-VA settings (assisted living facilities, nursing homes, and general clinics serving veterans) should consider assessing patients and clients for both alcohol and drug use disorders. The provision of psycho-education has been recommended as a method to destigmatize problem drug use, manage craving to use, and improve care for veterans with DUDs.[84,112] Healthcare outside of VA should utilize appropriate diagnostic screening tools to assess SUDs in veterans.

These study findings indicate that there has been a gradual decrease in AUD prevalence reported in both the studies using diagnostic and those using administrative criteria sampling US veterans over the past 20 years. It is important to note, however, that the majority of the studies report data collection in the 1990s, with a few in the early 2000s, and only one study collected data until 2010. Therefore, few studies reflect the experiences of more recent OEF/OIF veterans. In contrast, data from the recent National Survey on Drug Use and Health (NSDUH) suggests that the prevalence of persons with any substance use disorder (including AUDs) in the general US population has been stable since at least 2010 (ranging from 20.6 to 22.7 million Americans).[93] The differences in SUD trends between the general population and US veterans could be attributed to the variations in the age structure between the two populations. Specifically, the gradual decline of AUD prevalence among studies sampling US veterans could be a result of the continuing trend of the aging veteran population. For example, between 1992 and 2013, the percentages of veterans under the age of 45 decreased (32% vs. 21%), while the proportion above the age of 65 increased (38% vs. 26%).[113] However, further studies are needed to examine more current trends in the prevalence of SUDs among US veterans, particularly veterans of more recent conflicts.

Limitations

The findings of this study should be interpreted with caution and in the context of several potential limitations. First, since one of our goals was to compare administrative and diagnostic criteria, we did not include studies that reported prevalence based on screening

efforts alone. Second, administrative data reflect diagnoses assigned by clinicians to patients during their episodes of inpatient and outpatient care. In these settings, patients with less severe SUDs may go undiagnosed. Several studies have suggested that clinicians within the VHA routinely under-diagnose SUDs.[84,114] Since the majority of the studies did not report the specific ICD-9 codes used to identify AUDs and DUDs, we were unable to compare and contrast the similarities and differences between the codes utilized in administrative data. Despite this potential limitation, the use of VA administrative data provides important information from all veterans treated in facilities throughout the country, and offers the benefits of examining the prevalence and correlates of SUDs in a large national cohort of US veterans with the caveat of differential access to medical care.

Third, we note that some of the studies using both administrative data and diagnostic criteria sampled veterans who may have a significantly elevated rate of SUDs compared to the general veterans population. These include, for example, HIV-infected veterans, homeless veterans, veterans with PTSD, and those sampled from inpatient clinical settings. Differences in sampling design and other study methods likely account for some of the observed variation in SUD prevalence, even among studies using similar assessment methodology and recruiting veterans from the same era. To reduce variability, we excluded studies that sampled veterans entirely from substance abuse treatment programs. In sensitivity analyses, we excluded studies sampling veterans of specific clinical interest (eg, those with spinal cord injuries, homeless veterans, and veterans with PTSD), and found that trends did not differ substantially in this sub-group.

Fourth, the differences in study design, survey, and screening methodologies among the eligible studies may have limited the implications of this review, particularly the assessment of trends in prevalence over time. For example, variation in the assessment periods for the studies included in the final analyses may have accounted for some of the observed changes in SUD prevalence over time, and may not be representative of the true trends in prevalence of SUDs among larger US veteran populations. Notably, the studies included in this analysis have significant heterogeneity in terms of the timeframe for assessment and the population studied. The majority (70%) of the 37 studies using diagnostic criteria measured lifetime SUDs, whereas only 14% of the 35 studies using administrative assessment method reported lifetime prevalence. The sub-analyses for lifetime and past year AUDs and DUDs show that the two assessment methods suggest similar time trends for AUDS but differ in DUDs. Therefore, some of the observed differences in pooled SUD prevalence across the two assessment methods and trends over time may have been due to variations in the recall periods (ie, lifetime prevalence versus past-year). The findings point to the need to collect and report consistent assessment periods in order to improve comparability of the prevalence of SUDs across studies and also over time.

Fifth, we note that assessing the temporal trends by the year of data collection (rather than publication year) may have provided a more accurate characterization of the changes in SUD prevalence over time. However, we were unable to do so with all the eligible studies, as many of them did not report the years of data collection (more than half of the studies using clinical diagnosis criteria and more than one-fifth of the studies using administrative criteria), reported only the era from which the veterans were sampled (eg, Vietnam), or only

provided a broad time frame during which the data was collected. Therefore, we were only able to conduct a sub-analysis among 17 studies using clinical diagnostic criteria and 26 studies using administrative criteria that reported these dates. The findings show similar time trends as in the main analyses using publication dates; however, we did observe that administrative studies are more common in recent years of data collection. We also acknowledge that, due to OEF and OIF, there is an important shift in the characteristics of veterans after 2001, and this analysis may be limited in identifying specific changes in SUD prevalence among OEF/OIF veterans over the past decade.

Sixth, even though meta-analytic techniques offer a more rigorous evaluation of prevalence and other effect estimates, we did not conduct a meta-analysis due to the fact that our target population has changed substantially over time. Instead of pooling these data together to produce one summary effect, we were interested in identifying long-term trends in SUD prevalence reported in the studies sampling US veterans and in determining the qualitative differences between administrative and diagnostic assessments. Seventh, even though the definition of substance abuse/dependence in DSM-V was recently updated in May 2013, this study still reports on substance abuse/dependence using DSM-IV and DSM-III-R diagnostic criteria due to the fact that the majority of the eligible studies still assessed substance abuse/dependence in this manner. Further research is needed to identify the differences between various diagnostic tools and its impact on estimating the prevalence of SUD among US veterans. Additionally, DUDs assessed in the sampled studies may have included a variety of single substance or polysubstance use disorders, and may not adequately capture a particular drug of abuse in the sampled population. Finally, we note that our results are based primarily on the selected studies and may not be generalizable to all US veterans from all eras.

CONCLUSIONS

In summary, the findings show that studies using diagnostic criteria reported higher rates of SUDs (including both AUDs and DUDs) compared to studies using administrative criteria, although the differences have diminished over time. These findings have particularly important implications for research assessment and prevalence estimates of SUDs among US veterans. Specifically, the data show that resources and programs to expand SUDs screening in US veterans populations are needed, given the higher prevalence of SUDs reported in the studies sampling US veterans using diagnostic criteria. The military now conducts universal screening for high-risk alcohol use.[7] Yet, neither VA nor the military conducts universal screening for non-alcohol substance misuse.[84] Given the significant public health problems of SUDs among US veterans, this population should receive increased clinical attention. There is potential merit in universal SUDs screening and the guideline for universal SUDs screening should be reconsidered for this population. In summary, these findings may inform VA and other healthcare systems in improved clinical diagnosis, prevention, and intervention for SUDs among US veterans.

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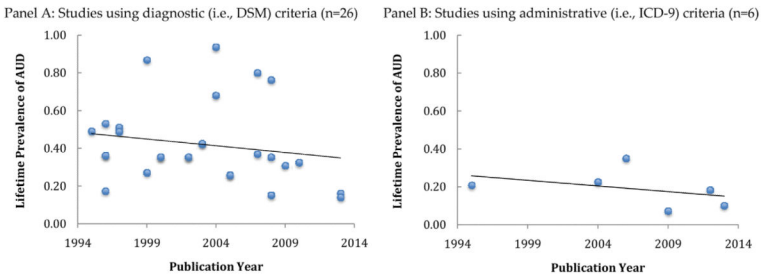

FIGURE 1.

Prevalence of lifetime alcohol use disorders (AUDs) among US veterans reported by studies using diagnostic (ie, DSM) criteria (Panel A) and administrative (ie, ICD-9) criteria (Panel B), by publication year. Note: black solid lines represent trend lines, calculated using weighted least squares regression. Note: Some of the data points overlap with each other since they had the same or very similar data point. DSM, Diagnostic and Statistical Manual of Mental Disorders; DUD, drug use disorder; ICD-9, international classification of diseases.

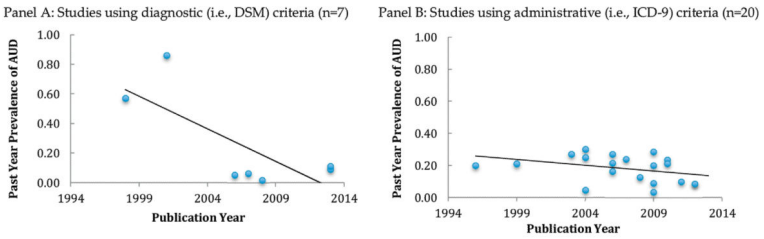

FIGURE 2.

Prevalence of past year alcohol use disorders (AUDs) among US veterans reported by studies using diagnostic (ie, DSM) criteria (Panel A) and administrative (ie, ICD-9) criteria (Panel B), by publication year. Note: black solid lines represent trend lines, calculated using weighted least squares regression. Note: Some of the data points overlap with each other since they had the same or very similar data point. AUD, alcohol use disorder; DSM, Diagnostic and Statistical Manual of Mental Disorders; ICD-9, international classification of diseases.

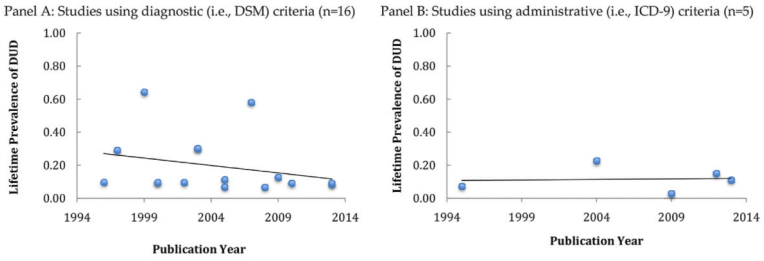

FIGURE 3.

Prevalence of lifetime drug use disorders (DUDs) among US veterans reported by studies using diagnostic (ie, DSM) criteria (Panel A) and administrative (ie, ICD-9) criteria (Panel B), by publication year. Note: black solid lines represent trend lines, calculated using weighted least squares regression. Note: Some of the data points overlap with each other since they had the same or very similar data point. AUD, alcohol use disorder; DSM, Diagnostic and Statistical Manual of Mental Disorders; ICD-9, international classification of diseases.

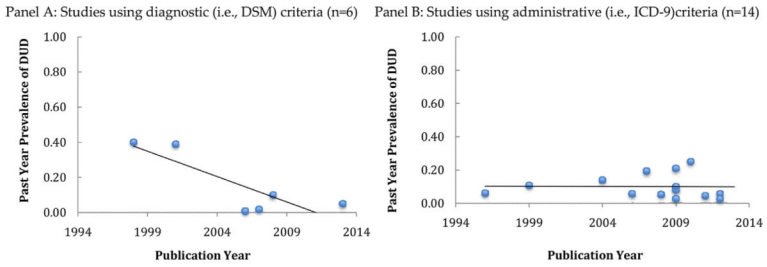

FIGURE 4.

Prevalence of past year drug use disorders (DUDs) among US veterans reported by studies using diagnostic (ie, DSM) criteria (Panel A) and administrative (ie, ICD-9) criteria (Panel B), by publication year. Note: black solid lines represent trend line, calculated using weighted least squares regression. Note: Some of the data points overlap with each other since they had the same or very similar data point. AUD, alcohol use disorder; DSM, Diagnostic and Statistical Manual of Mental Disorders; ICD-9, international classification of diseases.

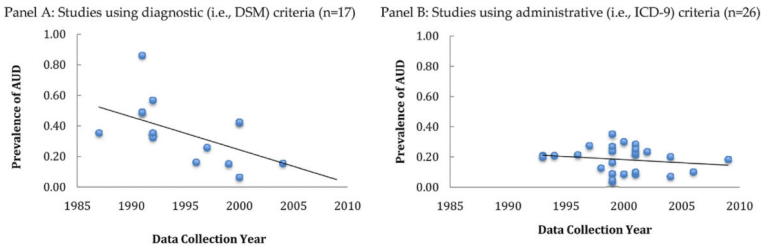

FIGURE 5.

Prevalence of alcohol use disorders (AUDs) among US veterans reported by studies using diagnostic (ie, DSM) criteria (Panel A) and administrative (ie, ICD-9) criteria (Panel B), by earliest data collection year. Note: black solid lines represent trend line, calculated using weighted least squares regression. Note: 18 studies are not presented in Panel A due lack of report on the year of data collection. DSM, Diagnostic and Statistical Manual of Mental Disorders; DUD, drug use disorder; ICD-9, international classification of diseases.

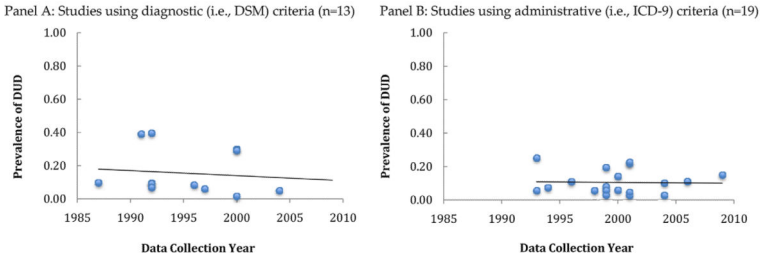

FIGURE 6.

Prevalence of drug use disorders (DUDs) among US veterans reported by studies using diagnostic (ie, DSM) criteria (Panel A) and administrative (ie, ICD-9) criteria (Panel B), by earliest data collection year. Note: black solid lines represent trend line, calculated using weighted least squares regression. Note: 9 studies are not presented in Panel A due lack of report on the year of data collection. DSM, Diagnostic and Statistical Manual of Mental Disorders; DUD, drug use disorder; ICD-9, international classification of diseases.

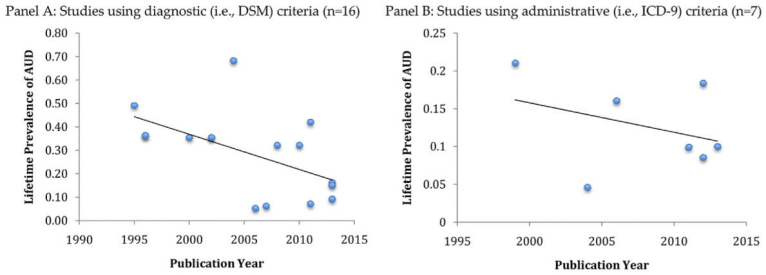

FIGURE 7.

Prevalence of alcohol use disorders (AUDs) among US veterans reported by studies with representative sampling methods using diagnostic (ie, DSM) criteria (Panel A) and administrative (ie, ICD-9) criteria (Panel B), by publication year. Note: black solid lines represent trend lines, calculated using weighted least squares regression. Note: Some of the data points overlap with each other since they had the same or very similar data point. DSM, Diagnostic and Statistical Manual of Mental Disorders; DUD, drug use disorder; ICD-9, international classification of diseases.

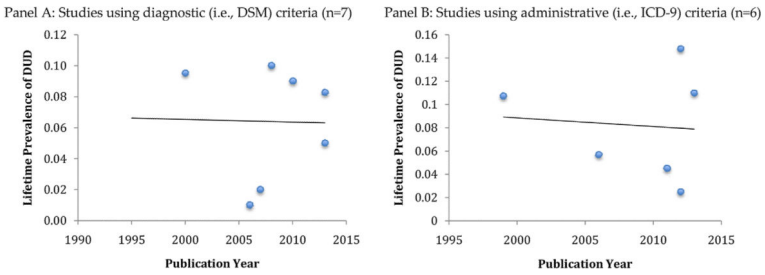

FIGURE 8.

Prevalence of drug use disorders (DUDs) among US veterans reported by studies with representative sampling methods using diagnostic (ie, DSM) criteria (Panel A) and administrative (ie, ICD-9) criteria (Panel B), by publication year. Note: black solid lines represent trend lines, calculated using weighted least squares regression. AUD, alcohol use disorder; DSM, Diagnostic and Statistical Manual of Mental Disorders; ICD-9, international classification of diseases.

TABLE 1

Studies using diagnostic criteria to examine SUDs among US veterans (n=37)

Author, Year	Era or years sampled	Study population			SUDs		Assessment period	Principal findings
		Total no.	% Women	Sample	AUD (%)	DUD (%)		
Balan (2013)	Vietnam	642	0	Combat veterans deployed to Vietnam	16	8	Lifetime	12% reported PTSD. Prevalence of DUDs declined from 29.8% in 1972 to 8.3% in 1996.
Black (2004)	Gulf war	132	12	Population-based survey of military personnel	68	—	Lifetime	Lifetime SUDs were significantly more frequent in deployed than non-deployed veterans (70% vs. 52%), particularly AUDs (68% vs. 52%).
Callaghan (1996)	1994	97	0	Veterans with spinal cord injuries	40		Lifetime	Prescription of benzodiazepines was not significantly greater in veterans with a spinal cord injury and diagnosed with SUDs than those without SUDs.
Crawford (2013)	After 2001	1,775	2	Anyone with military service after September 11, 2001	9	—	Past year	Significance gender difference in AUDs prevalence were observed: the rate of any AUDs was higher among men (10%) compared to women (6%).
David (1999)	Vietnam	53	0	Personnel diagnosed with combat-related PTSD	87	64	Lifetime	Veterans with PTSD were sampled. No association was found between psychotic symptoms and a lifetime history of AUDs or DUDs.
David (2004)	1997–1999	93	0	Male veterans admitted to rehabilitation for PTSD	94	—	Lifetime	59% PTSD. Association between alcohol dependence and certain medical conditions is likely mediated by adverse health behaviors.
Dickerson (2009)	1999–2001	480	0	Community-based survey of American Indian male veterans	31	13	Lifetime	12% PTSD. Substantial co-morbidity exists between nicotine dependence and other substance abuse.
Ditre (2005)	2003	124	—	Veterans with spinal cord injury	26	11	Lifetime	Intoxication at injury does not necessarily substantiate the existence of an underlying substance misuse problem.
Fiedler (2006)	Gulf war	967	10	Random sample from all US troops	5	1	Past year	3% PTSD. Gulf War veterans had significantly higher prevalence of psychiatric diagnosis, with twice the prevalence of anxiety disorders and depression.
Fu (2002)	Vietnam	6,720	0	Veterans served in Vietnam Era	35	—	Lifetime	Genetic effects on antisocial personality disorder are a major determinant of risk of SUDs.
Fu (2002)	Vietnam	7,369	0	Veterans served in Vietnam Era	35	10	Lifetime	10% PTSD. There may be a genetic susceptibility specific to both suicidal ideation and suicide attempt in men.
Gale (2008)	Vietnam	3,258	0	Random sampling from veterans served in Vietnam	32	10	Past year	10% PTSD. Lower cognitive ability was associated with an increased risk of depression, AUDs and PTSD.
Golub (2013)	OEF/OIF	3,826	18	National Survey on Drug Use and Health	15	5	Past year	18% has any SUDs. The prevalence of untreated SUDs among veterans was twice as high as untreated serious psychological distress.

Author, Year	Era or years sampled	Study population: Total no.	Study population: % Women	Study population: Sample	SUDs: AUD (%)	SUDs: DUD (%)	Assessment period	Principal findings
Grand (2007)	2005	231	0	Nicotine Dependent veterans	80	58	Lifetime	22% PTSD. Lower quit rates among smokers with AUDs and suggests that specialized treatment is needed for this population of smokers.
Grant (2010)	Vietnam	6,362	0	Male veterans served between 1939–1957	32	9	Lifetime	The analyses indicate that cannabis initiation, whether early or late, confer risk for other substance use and SUDs that is independent of familial influences.
Grossman (1997)	1992–1993	62	50	Hospitalized female veterans	56		Lifetime	More men were diagnosed with PTSD or SUDs than women.
Hamner (1997)	Vietnam	25	0	Veterans with PTSD	51	29	Lifetime	Psychotic phenomena occur in association with chronic PTSD in a Vietnam combat veteran population.
Hamner (1999)	Vietnam	45	0	Veterans with PTSD but no primary psychotic disorder	27	—	Lifetime	The occurrence of psychotic features in PTSD is not necessarily due to a primary psychotic disorder.
Herrmann (1996)	WWII	76	—	Veterans with PTSD	53	—	Lifetime	There was a significant correlation between the severity of combat stress and subsequent alcohol abuse.
Humphreys (2012)	Vietnam	926	0	Veterans with PTSD	21	—	Past year	Antisocial personality disorder comorbidities in reduced physiological reactivity to trauma reminders are present in some individuals with PTSD.
Joseph (1995)	1991–1993	117	3	Residents of VA nursing home	49	—	Lifetime	The prevalence of AUDs was high in the sample. CAGE and MAST-G test are both sensitive to AUDs in the setting.
Kasprow (1998)	50% Vietnam Era	36,928	2	Homeless Native American veterans	57	40	Past year	Native Americans veterans reported more current AUDs and they have more severe alcohol problems than other minority groups but fewer psychiatric problems.
Kausch (2003)	2000–2001	114	9	Veterans treated for pathological gambling	42	30	Lifetime	5% PTSD. Impulsivity score of gamblers with both AUDs and DUDs who had suicide attempts was higher than those without.
Kilbourne (2005)	1997–2000	330	9	Patients with bipolar disorder	26	7	Lifetime	Minorities with bipolar disorder may be a more vulnerable population because of high rates of SUDs.
Miller (2008)	Vietnam	1,325	0	Veterans with PTSD	76	—	Lifetime	72% PTSD. 58% of the sample was diagnosed with lifetime SUDs.
Miller (2011)	49% Vietnam	555	11	Veterans who used health service at VA	42		Lifetime	Greater comorbidity of SUD among those who met PTSD criteria.
Miller (2013)	2011	242	1	Veterans with history of exposure to a traumatic event	14	9	Lifetime	43% PTSD. 17% SUD; partner alcohol and drug use explained more variance in veterans' alcohol and drug use.
Morton (1996)	1994	120	0	64 or older veterans	36	—	Lifetime	The MAST-G and the CAGE outperformed the AUDIT for detecting AUDs.
O'Toole (2003)	Vietnam & Gulf war	127	0	Homeless veterans	80		Past year	18% PTSD. Homeless veterans reported greater percentage of SUDs and continue to have substantial health issues that need improved access to VA services.

Author, Year	Era or years sampled	Study population			SUDs		Assessment period	Principal findings
		Total no.	% Women	Sample	AUD (%)	DUD (%)		
Orsillo (1996)	Vietnam	311	0	Veterans experienced war zone-related trauma	17	10	Lifetime	63% PTSD. Veterans with PTSD had significantly higher rates of AUDs, major depression, and panic disorder.
Ouimette (1996)	Vietnam	47	1	Female veterans served during Vietnam Era	36	—	Lifetime	53% PTSD. Women with PTSD and AUDs reported more childhood sexual abuse and victimization during wartime.
Sajatovic (2006)	1997–2000	184	9	Veterans with bipolar disorder	38	—	Past year	Having current SUDs was associated with medication non-adherence.
Wagner (2007)	2000–2003	12,072	10	National Survey on Drug Use and Health	6	2	Past year	Veterans and comparable nonveterans reported similar rates of AUDs and DUDs in the last year.
Westermeyer (2008)	1999–2001	417	14	American Indian veterans	15	—	Lifetime	8% PTSD. Those with DUDs showed trends for an association with gambling while AUDs was not associated with gambling.
White (2011)	2008	17,641	0	National Survey on Drug Use and Health	7		Past year	Military status was not differentially associated with past year AUDs or DUDs.
Xian (2000)	Vietnam	6,608	0	Population registry	35	10	Lifetime	10% PTSD. The liability for PTSD was partially due to a 15% genetic contribution common to AUDs and DUDs.
Yovtcheva (2001)	1991–2000	306	3	Hepatitis C-positive patients	86	39	Past year	Participants with AUDs have hepatitis C sero-positivity rates higher than the general population. 19% reported PTSD.

SUD, substance use disorder; AUD, alcohol use disorder; DUD, drug use disorder; PTSD, posttraumatic stress disorder; NSDUH, National Survey on Drug Use and Health.

TABLE 2

Studies using administrative data to examine SUDs among US veterans (*n*=35)

Author, Year	Era or years sampled	Study Population			SUDs		Assessment period	Principal findings
		Total	% Women	Study setting	AUD (%)	DUD (%)		
Anderson (1995)	29% Vietnam	125,267	3	Veterans diagnosed with suicide attempt compared with non-suicidal	21	7	Lifetime	Substance-abusing suicidal inpatients received nearly twice as many SUDs diagnosis. 4% reported PTSD.
Andersen (2010)	OEF/OIF	4,416	11	Veterans served between 2001 to 2007	10		Lifetime	Physical health effects are associated with PTSD in the early years post deployment among OEF/OIF veterans. 6% reported PTSD.
Banerjea (2009)	1999–2002	8,338	2	Veterans with spinal cord injury	9	8	Past year	26% any SUDs; 46% VHA users with spinal cord injuries had either a MI or SUDs. 6% reported PTSD.
Banerjea (2009)	1999–2000	16,368	1	Veterans with diabetes	4	3	Past year	13% SUDs; 45% had a mental illness (MI), SUDs, or both; SUDs rates were high among those with serious MI.
Bohnert (2013)	2005–2007	272, 509	6	Veterans with PTSD	19		Past year	19% SUDs among the PTSD cohort.
Bohnert (2012)	2000–2006	3,291,891	10	Patients who use VA services in 1999	9	6	Past year	10% SUDs; death from accidental overdose was found to be associated with psychiatric and SUDs. 6% reported PTSD.
Butt (2007)	1999–2003	253,942	3	HCV-infected and uninfected veterans	24	19	Past year	The association of between HCV and psychiatric diagnosis is at partially attributable to AUDs and DUDs. 11% reported PTSD.
Butt (2009)	2001–2006	171,665	3	HCV-infected veteran receiving care at VA	28	21	Past year	HCV-infected subjects were more likely to abuse alcohol and drugs.
Butt (2010)	1998–2003	16,043	4	VA National Patient Care database	27		Past year	Non-completers for HCV treatment were more likely to have SUDs.
Chermack (2012)	2001–2007	3,942,948	9	All patients seen at VA in 2001	9	3	Past year	A diagnosis of SUDs was significantly associated with death by homicide.
Conigliaro (2003)	1999–2000	881	1	HIV-infected veteran	27	—	Past year	Among HIV-infected cohort, alcohol diagnosis was common and associated with HIV disease progression.
Copeland (2012)	2002	254,051	5	Obese primary care patients	3		Past year	VHA efforts to help obese patients manage their weight appeared more common for patients with psychiatric diagnoses. 6% PTSD.
Crothers (2006)	2001–2002	1,727	0	HIV-positive and negative male veteran	22	—	Past year	HIV-positive subjects were more likely to have received a diagnosis of AUDs.
Edelman (2013)	2006	78, 748	3	Receiving care at VA in 2006	10	11	Past year	9% PTSD; patients receiving opioids had a greater prevalence of AUDs, DUDs, and major depression.
Edens (2012)	8% OEF/OIF	1,102,846	9	VA data in 2009	18	15	Lifetime	DUDs had no significant independent association with pathological gambling. 38% PTSD.

Author, Year	Era or years sampled	Study Population: Total	Study Population: % Women	Study Population: Study setting	SUDs: AUD (%)	SUDs: DUD (%)	Assessment period	Principal findings
Freiberg (2010)	2002–2006	4,743	0	HIV-infected and uninfected veterans	23	—	Past year	Among HIV-infected men, AUDs was associated with higher prevalence of cardiovascular diseases
Green (2010)	61% Vietnam	6,351	5	Veteran Aging Cohort in 2002	21	25	Past year	Non-drug users were most prevalent among HIV uninfected. 10% PTSD.
Hoblyn (2009)	2004	2,963	14	Bipolar disorder Diagnoses	20	10	Past year	Patients diagnosed as having both an AUDs and DUDs and who were also separated from their partner had 100% risk of psychiatric hospitalization
Howard (1996)	1993	536,244	2	American Indian veterans	20	6	Past year	23% of the sample had SUDs. Native American veterans with SUDs were more likely to be diagnosed with AUDs and PTSD and less likely with DUDs. 2% PTSD.
Justice (2006)	1999–2000	866	1	Veterans with HIV	35	—	Lifetime, past year	Past and current use of alcohol is common among those with HIV.
Justice (2004)	2001–2002	1,803	—	Veteran with and without HIV	23	23	Lifetime	Older HIV-positive veterans demonstrate greater prevalence of AUDs and DUDs.
Kalman (2004)	1999	127,308	4	Veterans enrolled in VA in 1999	5	—	Past year	22% PTSD; respondents with history of AUDs had lower HRQoL.
Kilbourne (2004)	2001	4,310	10	Diagnosed with bipolar disorder	25	—	Past year	Individuals with bipolar disorder possess a substantial burden of general medical comorbidity, including AUDs.
Kilbourne (2004)	2000	813	11	Veterans with bipolar disorder	30	14	Past year	Older African American patients with bipolar disorder are more likely to receive diagnoses of mutually exclusive conditions such as schizophrenia. 14% PTSD.
McGinnis (2006)	1997–2004	42,054	0	Male veterans with first HIV diagnosis between 1997–2004	27	—	Past year	HIV-positive veterans have higher incidence of hepatocellular carcinoma and this association appears to be largely explained by higher prevalence of AUDs.
Pavao (2013)	2010	126,598	7	Homeless veterans	3		Past year	Of homeless veterans, 40% of females and 3% of males experienced military sexual trauma.
Petrakis (2011)	58% VET	1,001	11	Veterans with PTSD	21		Past year	41% PTSD. Post-VET were more likely to be dually diagnosed than veterans from other eras.
Rosen (2008)	Vietnam Era	169,051	0	VA psychiatric patients	13	5	Past year	The risk-adjusted probability of dying was 55% higher among psychiatric patients with co-occurring SUDs than those without. 47% PTSD.
Seal (2011)	OEF/OIF	456, 502	12	Veterans in OEF/OIF, 2001-2010	10	5	Past year	3% for both AUDs and DUDs; 26% PTSD.
Shi (2012)	2005–2008	878	28	Veteran with major depressive symptoms	37		Past year	Veterans with major depressive disorder treated with duloxetine were associated with lower risks of opioid use and SUDs.
Sloan (2006)	1999	914,225	5	VA National Patient Care Database	16	6	Past year	18% PTSD. Conditions like DUDs had higher outpatient utilization of care.
Smith (2011)	1999–2000	29,997	3	VA nursing home resident	21		Past year	Adults aged 45+ were included in the study. Those with SUDs aged 75 to 84 years had significantly higher total costs of

Author, Year	Era or years sampled	Study Population: Total	Study Population: % Women	Study Population: Study setting	SUDs: AUD (%)	SUDs: DUD (%)	Assessment period	Principal findings
								care than those aged 85 and above.
Striegel-Moore (1999)	1996	196	0	Inpatient veteran in 1996	21	11	Past year	High rate of comorbid SUDs and mood disorder for men with eating disorders.
Tiwari (2008)	1998–1999	3,953	4	Veteran with diabetes and major depressive disorder	18		Past year	15% PTSD. African Americans, older veterans, and those with SUDs were less likely to have guideline-consistent antidepressant treatment.
VanCott (2010)	1999–2004	832	3	VA patients 66 and older	21		Past year	Strongest predictor of suicide-related behaviors for older patients was a previous diagnosis of affective disorder.

SUDs, substance use disorders; AUDs, alcohol use disorders; DUDs, drug use disorders; HRQoL, health-related quality of life.