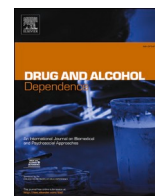




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Prevalence, risk and protective factors of alcohol use disorder during the COVID-19 pandemic in U.S. military veterans

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ABSTRACT

Background: There have been reports of increased alcohol consumption during the COVID-19 pandemic in the general population. However, little is known about the impact of the pandemic on the prevalence of alcohol use disorder (AUD), especially in high-risk samples such as U.S. military veterans.

Methods: Data were analyzed from the 2019–2020 National Health and Resilience in Veterans Study, which surveyed a nationally representative, prospective cohort of 3078 U.S. veterans. Pre-pandemic and 1-year peri-pandemic risk and protective factors associated with incident and chronic probable AUD were examined.

Results: A total of 6.9 % (n = 183) of veterans were classified as chronic probable AUD, 3.2 % (n = 85) as remitted from AUD, and 2.7 % (n = 71) as incident probable AUD during the pandemic; the prevalence of probable AUD in the full sample remained stable —10.1 % pre-pandemic and 9.6 % peri-pandemic. Younger age, greater pre-pandemic alcohol use severity, and COVID-related stressors were associated with incident AUD during the pandemic, whereas higher pre-pandemic household income was associated with lower risk of this outcome. Younger age, combat experience, lifetime substance use disorder, greater drug use severity, lower dispositional optimism, and more COVID-related worries and social restriction stress were associated with higher risk of chronic AUD.

Conclusions: Nearly 1-in-10 US veterans screened positive for AUD 1-year into the pandemic; however, the pre- and 1-year peri-pandemic prevalence of probable AUD remained stable. Veterans who are younger, have served in combat roles, endorse more COVID-related stressors, and have fewer socioeconomic resources may be at higher risk for AUD during the pandemic.

1. Introduction

Alcohol use disorder (AUD) is a significant public health concern, and accounts for 3 million deaths worldwide every year (World Health Organization, 2018). Recently, the coronavirus disease 2019 (COVID-19) pandemic has negatively impacted the world, resulting in increased social isolation, financial and psychological distress, and excessive mortality (Czeisler et al., 2020; Faust et al., 2021). Given the many stressors associated with the pandemic, there have been concerns

of possible increases in alcohol use, relapse, and the development of AUD, especially in high-risk populations (Clay and Parker, 2020).

To date, the majority of studies have focused on alcohol consumption during the COVID-19 pandemic. For example, large population-based surveys conducted in the US, UK, Canada, Germany, Belgium, and Brazil have reported increases in the amount and frequency of alcohol use (Gonçalves et al., 2020; Koopmann et al., 2020; Nanos Research, 2020; Pollard et al., 2020; The Lancet Gastroenterology and Hepatology, 2020). To date, however, scarce research has examined changes in the

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prevalence of AUD during the pandemic.

One population that may be at particularly elevated risk for increased alcohol consumption and AUD during the pandemic are U.S. military veterans. Even prior to the pandemic, veterans had a higher prevalence of AUD relative to non-veterans (Williamson et al., 2018). For example, in a nationally representative survey of veterans, the lifetime and past-year prevalence of AUD was 42.2 % and 14.8 %, respectively (Fuehrlein et al., 2016), whereas in the general U.S. adult population was estimated at 29.1 % and 13.9 %, respectively (Grant et al., 2015). Veterans tend to be older, more socially isolated, and may be more vulnerable to the negative psychological effects of the pandemic due to higher prevalence of pre-existing psychiatric and medical conditions compared to non-veterans (Dohrenwend et al., 2006; Pietrzak et al., 2014; Villa et al., 2003). Further, previous studies on veterans have found that stressful events (e.g., combat deployments), are linked to an increased likelihood of being diagnosed with AUD (Kelsall et al., 2015; Shen et al., 2012).

To date, no known study has examined whether COVID-related stressors are associated with increased risk for AUD. Theoretical models of addiction, including the traditional negative reinforcement model (Wills and Shiffman, 1985), affective processing model of negative reinforcement (Baker et al., 2004), and motivational model of alcohol use (Cooper et al., 1995) posit that increasing stressors and resultant negative affect may motivate substance use and that substance use may serve as a means to cope with this distress. Based on these models, one might hypothesize that individuals who experience greater COVID-related stressors may be at heightened risk of AUD during the pandemic. Indeed, studies have shown that COVID-related worries and increased media consumption were associated with heightened mental health burden, which may increase risk of AUD in individuals (Bendau et al., 2021; Gunnell et al., 2020). Further, previous studies of the 2003 severe acute respiratory syndrome (SARS) outbreak have found that hospital employees in Beijing, China who were either in quarantine or worked in high-risk inpatient units were 1.5 times more likely to report symptoms of AUD three years after the SARS outbreak relative to non-exposed hospital employees (Wu et al., 2008). Identifying potential risk and protective factors of AUD in the midst of the pandemic may be of clinical utility to help inform understanding of individuals who are at heightened risk and who might benefit from prevention and treatment efforts. For example, the Veterans Health Administration (VHA) implemented the practice of identifying veterans at heightened risk of suicidal behavior based on research concerning risk and protective factors of suicide, and flagging such identified individuals in their electronic health records to mitigate suicide risk (Veterans Health Administration, 2008). Paralleling such practices, identification of risk and protective factors of AUD may help inform efforts at the VHA and other health care settings that serve veterans to monitor veterans who may be at heightened risk of AUD during the pandemic.

A review of AUD during disasters (e.g., World Trade Center attack, SARS outbreak, and the 2008 Great Recession) identified risk factors such as sociodemographic characteristics (e.g. younger age, male, socioeconomic adversities); high proximity/exposure to the event; underlying psychiatric disorders; and increased psychological distress (Gonçalves et al., 2020). This review further suggested that having a structured routine, performing protective psychosocial activities (e.g. activities involving family, friends, and exercise) and adaptive coping skills may help mitigate risk for AUD in disaster situations (Gonçalves et al., 2020; Moos, 2007). However, opportunities to engage in social activities have been largely restricted during the pandemic, which suggests that risk of AUD may be heightened during the pandemic.

Thus, a significant limitation of the extant literature is the lack of information on the prevalence, and pre- and peri-pandemic risk and protective factors associated with AUD among high-risk samples, such as U.S. military veterans. Indeed, the majority of extant research on alcohol use during the pandemic has focused on non-representative, cross-sectional/retrospective surveys, largely in the general population. To

date, however, no known study has examined courses of AUD in the U.S. veteran population, who are a known group to have higher prevalence of AUD even prior to the pandemic and who have been identified as a possible vulnerable group due to previous trauma exposures (Marini et al., 2020).

To address these gaps, we analyzed data from the National Health and Resilience in Veterans Study (NHRVS), which surveyed a prospective, nationally representative sample of 3078 U.S. military veterans shortly before the pandemic and again 1-year later during the pandemic, to evaluate the following two aims: (1) to examine the prevalence of different courses of chronic (i.e., screened positive for AUD at both pre- and 1-year peri-pandemic assessments), incident (i.e., screened negative for AUD at pre-pandemic, but positive for AUD at the peri-pandemic assessment), and remitted probable AUD (i.e., screened positive for AUD at pre-pandemic but not at the peri-pandemic assessment) from prior to the pandemic to one year into the pandemic; and (2) to identify pre- and peri-pandemic risk and protective factors associated with symptomatic courses of AUD. Based on motivational models of addiction (Baker et al., 2004; Cooper et al., 1995), and previous disaster research (Gonçalves et al., 2020) we hypothesized that veterans with chronic or incident AUD peri-pandemic would be younger, have more socioeconomic adversities and psychiatric comorbidities, experience greater psychological distress and lower perceived social support, and experience more COVID-related stressors relative to those who remitted or did not screen positive for AUD over the study period.

2. Material and methods

2.1. Participants

Data were analyzed from the 2019–2020 NHRVS, which surveyed a nationally representative prospective sample of U.S. military veterans. Of the 4069 veterans who completed an initial survey prior to the first documented COVID-19 case in the U.S. (i.e., pre-pandemic survey; median completion date: 11/21/2019), 3078 (75.6 %) completed a 1-year peri-pandemic follow-up assessment (median completion date: 11/14/2020). Both surveys were online, 60-minutes, self-report surveys. All participants received 15,000 points (equivalent to \$15) for participating in the pre-pandemic survey, and 20,000 points (equivalent to \$20) for participating in the peri-pandemic survey. Details of the study design has been described previously (Fogle et al., 2020; Tsai et al., 2020). Briefly, the NHRVS sample was drawn from KnowledgePanel®, a survey research panel of more than 50,000 U.S. households maintained by Ipsos, a survey research firm. To promote generalizability of the results to the U.S. veteran population, poststratification weights based on the demographic distribution of veterans in the U.S. Census Current Population Survey were applied in inferential analyses. The study protocol was approved by the Human Subjects Committee of the VA Connecticut Healthcare System, and all participants provided informed consent.

2.2. Assessments

2.2.1. Alcohol use disorder

Pre- and peri-pandemic probable AUD were assessed using the Alcohol Use Disorders Identification Test (AUDIT), a validated measure used to screen for AUD. The AUDIT consists of 10 questions that assess the severity of alcohol consumption and consequences and yield a total score ranging from 0 to 40. Higher scores indicate more severe problematic alcohol use. A cut-off score of 8 or higher was considered as indicative of probable AUD (Babor et al., 1992).

2.2.2. Sociodemographic characteristics

Information on age, gender, race, education, marital status, annual household income (\geq \$60,000 vs. $<$ \$60,000 defined on the basis of median split of income categories), and combat veteran status was assessed at baseline.

2.2.3. Pre-pandemic risk factors

2.2.3.1. Lifetime psychiatric diagnoses. Probable lifetime diagnoses of major depressive disorder (MDD), PTSD, AUD, and/or drug use disorder (DUD) were assessed using a modified self-report version of the Mini International Neuropsychiatric Interview (MINI) (Sheehan, 2016).

2.2.3.2. Pre-pandemic psychiatric symptom severity. Baseline MDD symptom severity was assessed using the two items on the Patient Health Questionnaire (PHQ)-4, which assess depressive symptoms in the past two weeks (Kroenke et al., 2009). Baseline PTSD symptom severity was assessed using the past-month version of the PTSD Checklist for DSM-5 (Weathers et al., 2013b). Baseline generalized anxiety disorder symptom severity was assessed using the two items on the PHQ-4 that assess generalized anxiety symptoms in the past two weeks (Kroenke et al., 2009).

2.2.3.3. Non-prescription drug use days. Response to the following question from the Screen of Drug Use (Tiet et al., 2015): “How many days in the past year have you used non-prescription drugs?”

2.2.3.4. Adverse childhood experiences (ACEs). Score on ACEs Questionnaire (Felitti et al., 1998), a 10-item questionnaire in seven categories of childhood exposure to adverse experiences (e.g., psychological, physical, or sexual abuse; violence against mother; or living with household members who had a substance use problem, mental illness, or suicidal behavior, or were ever imprisoned).

2.2.3.5. Lifetime trauma burden. Count of potentially traumatic events on the Life Events Checklist for DSM-5 (LEC-5) (Weathers et al., 2013a). The LEC-5 assesses exposure to 16 events that may potentially result in PTSD or distress, with an additional item assessing any other stressful event not captured in the 16 items.

2.2.3.6. Loneliness. Score on 3-item measure adapted from the UCLA Loneliness Scale that assesses three components of loneliness, including the extent to which an individual feels left out, isolated, or that they lack companionship (Hughes et al., 2004).

2.2.3.7. Number of medical conditions. Sum of number of medical conditions endorsed in response to question: “Has a doctor or healthcare professional ever told you that you have any of the following medical conditions?” (e.g., arthritis, cancer, diabetes, heart disease, asthma, kidney disease). Range: 0–24 conditions.

2.2.4. Pre-pandemic protective factors

2.2.4.1. Protective psychosocial characteristics. The NHRVS measured a number of protective factors utilizing different scales and items (Pietrzak and Cook, 2013). As described in detail elsewhere (Pietrzak et al., 2014), protective psychosocial characteristics factor was created using exploratory factor analyses with oblique rotation. The protective psychosocial characteristics factor assessed individual-level qualities that previous research has identified as being protective against psychopathology, including 1) resilience (Campbell-Sills and Stein, 2007); 2) purpose in life (Schulenberg et al., 2010); 3) dispositional optimism (Scheier et al., 1994); 4) dispositional gratitude (McCullough et al., 2002); 5) curiosity (Kashdan et al., 2009); and 6) community integration. In the current sample, this factor had an eigenvalue of 3.72, 62.0 % cumulative variance explained, and factor loadings ranging from 0.69–0.84.

2.2.4.2. Social support. Score on an abbreviated 5-item version of the Medical Outcomes Study Social Support Scale (Cohen et al., 1985; Sherbourne and Stewart, 1991) was used to assess perceived social

support (sample item: “How often is each of the following kinds of support available to you if you need it?: Someone to confide in or talk to about your problems”; $\alpha = 0.89$).

2.2.5. COVID-related stressors

2.2.5.1. COVID-related variables. COVID-related exposure was assessed using the Assessment of Exposure to COVID-19 Scale developed by the National Center for PTSD. This measure assesses COVID-19 testing status of an individual and household/non-household members, as well as severity of COVID-19-related illness in those who had been infected, which range from no/mild symptoms to hospitalization (COVID-19-related death of household and non-household members is also assessed). Questions from the Coronavirus Health Impact Survey (National Institute of Mental Health Intramural Research Program Mood Spectrum Collaboration and Child Mind Institute of the NYS Nathan S. Kline Institute for Psychiatric Research, 2020) were used to assess hours spent consuming COVID-related media, and COVID infection-related worries (e.g., “In the past month, how worried have you been about being infected with coronavirus?”), social restriction stress (e.g., “How stressful have these changes in social contacts been for you?”), financial stress (e.g., “In the past month, to what degree have changes related to the pandemic created financial problems for you or your family?”), and relationship difficulties (e.g., “Has the quality of the relationships between you and members of your family changed?”).

A 4-item version of the PTSD Checklist for DSM-5 (i.e., four questionnaires on intrusive thoughts, avoidance of external reminders, negative expectations of self/world, and easily startled) was used to assess pandemic-related PTSD symptoms (range = 0–16, $\alpha = 0.75$; sample item: “Thinking about the Coronavirus/COVID-19 pandemic, please indicate how much you have been bothered by repeated, disturbing, and unwanted memories of the pandemic”); a score ≥ 5 is indicative of a positive screen for pandemic-related PTSD symptoms (Geier et al., 2020).

2.2.5.2. Change variables. Differences in scores (peri-pandemic – pre-pandemic) were computed for measures of loneliness, social support, and protective psychosocial characteristics.

2.3. Data analysis

Data analyses proceeded in three steps and were conducted in the 3078 veterans who completed both the pre- and peri-pandemic assessments. First, we conducted chi-square and independent-samples t tests to compare sociodemographic, psychosocial, and clinical characteristics between incident probable AUD vs. no AUD (i.e., screened negative for AUD at both pre- and peri-pandemic assessments), chronic probable AUD vs. remitted probable AUD; and chronic probable AUD vs. no AUD groups. The three comparisons were chosen to identify correlates of incident and chronic probable AUD that may be most clinically relevant. Second, we conducted multivariable binary logistic regression analyses to identify factors that independently differentiated incident and chronic probable AUD groups at peri-pandemic follow-up assessment. To identify a more inclusive list of variables for inclusion in multivariable analyses, variables that differed at the $p < 0.10$ level in bivariate analyses for each set of comparisons were entered into these models.

3. Results

Among the 4069 veterans who completed the pre-pandemic survey, the final sample included 3078 veterans who completed the 1-year follow-up peri-pandemic assessment. On average, the sample was 62.2 years old ($SD = 15.7$; range 22–99); the majority were male (90.2 %), and Caucasian (78.1 %), and 35.0 % were combat veterans. A total 6.9 % ($n = 183$) of the sample were classified as chronic probable AUD; 3.2 %

($n = 85$) as remitted from probable AUD; 2.7 % ($n = 71$) as incident probable AUD; and 87.2 % ($n = 2709$) did not screen positive for AUD at either the pre- or peri-pandemic assessments. In the full sample of 3078 veterans, the prevalence of probable AUD did not change over the 1-year study period: 10.1 % ($n = 268$) and 9.6 % ($n = 254$) veterans screened positive for AUD pre-pandemic and peri-pandemic, respectively (McNemar's test = 0.96, $p = 0.33$).

3.1. Baseline characteristics of participants by probable AUD status

Table 1 displays characteristics of veterans by probable AUD status. Using a $p < 0.05$ threshold to identify significant group differences, veterans who developed incident probable AUD relative to those who did not develop probable AUD were younger, and less educated. They reported more severe pre-pandemic alcohol use, loneliness, and less social support and protective psychosocial characteristics. They were also more likely to have lifetime histories of MDD/PTSD and/or AUD/DUD, spend more time consuming COVID-related media, endorse more COVID-related stressors, and were more likely to screen positive for pandemic-related stress symptoms.

Relative to veterans without probable AUD at either timepoint, those with chronic probable AUD were younger, more likely to be combat veterans and have lifetime psychiatric histories and traumas, reported greater severity of psychiatric and substance use symptoms at pre-pandemic, and scored lower on pre-pandemic protective psychosocial characteristics. They endorsed more COVID-related stressors, were more likely to screen positive for pandemic-related stress symptoms, and were more likely to report having been infected with COVID-19.

Relative to veterans who remitted from probable AUD, those with chronic probable AUD were younger, less likely to be married/partnered, more likely to be combat veterans, and report more severe pre-pandemic substance use.

3.2. Multivariable logistic regression analyses

Multivariable logistic regression analyses (Table 2) revealed that, relative to veterans who screened negative for probable AUD at the pre- and peri-pandemic assessments, those who developed incident probable AUD were younger, less likely to have a pre-pandemic annual household income of \$60,000 or higher, reported greater severity of pre-pandemic alcohol use problems, and endorsed more COVID-related worries, financial stressors, and decline in the quality of relationships. Post-hoc analyses revealed that worries about family or friends being infected with COVID-19 (OR = 1.47, 95 %CI = 1.14–1.89), pandemic-related financial problems (OR = 1.54, 95 %CI = 1.13–2.09), and stress related to changes in family relationships (OR = 1.44, 95 %CI = 1.04–1.99) were independently associated with incident probable AUD.

Relative to veterans who screened negative for AUD at the pre- and peri-pandemic assessments, veterans with chronic probable AUD were younger, more likely to be combat veterans, more likely to have lifetime AUD and/or DUD histories, reported more non-prescription drug use days, scored lower on a measure of protective psychosocial characteristics, and reported more COVID-related worries and social restriction stress. Post-hoc analyses revealed that lower pre-pandemic dispositional optimism (OR = 0.84, 95 %CI = 0.74–0.95), greater peri-pandemic worries about how the pandemic will affect one's physical health (OR = 1.24, 95 %CI = 1.07–1.43), and greater difficulty following recommendations for keeping away from close contact with others (OR = 1.23; 95 %CI = 1.04–1.45) were independently associated with chronic probable AUD.

Relative to veterans who remitted from probable AUD, veterans with chronic probable AUD were more likely to be combat veterans, and reported greater pre-pandemic alcohol use severity and non-prescription drug use days.

4. Discussion

To our knowledge, this study is the first to examine changes in the prevalence of probable AUD during the COVID-19 pandemic in a nationally representative sample of U.S. military veterans. Results revealed that nearly 1-in-10 veterans screened positive for AUD one-year into the pandemic, and that the prevalence of probable AUD remained largely unchanged during the pandemic. Younger age, higher pre-pandemic alcohol use severity, and COVID-related stressors were associated with increased risk of incident probable AUD, while higher pre-pandemic household income was associated with lower risk. Relative to veterans who screened negative for AUD, those with chronic probable AUD were younger and more likely to be combat veterans and have histories of AUD/DUD, and reported greater pre-pandemic drug use and COVID-related worries/stressors. They also scored lower on a pre-pandemic measure of protective psychosocial characteristics (i.e., dispositional optimism).

Many of the correlates of incident and chronic probable AUD during the pandemic were factors that have been associated with AUD in other settings, such as history of AUD/DUD, combat veteran status, and higher usage of non-prescription drugs. These comorbidities are concerning, given that deaths by overdose have been gradually increasing in the older adult population, which constitutes the majority of our study population (National Center for Health Statistics, 2018). These findings thus underscore the importance of systematic efforts to identify, monitor, and implement interventions to reduce alcohol and other substance use in veterans with these histories, as they may be at particularly high risk for developing long-term AUD and related issues.

With regard to protective factors, higher pre-pandemic dispositional optimism was found to be independently associated with lower risk of chronic probable AUD. Prior studies have found that dispositional optimism is linked to lower severity of PTSD and depressive symptoms (Nichter et al., 2020; Thomas et al., 2011). While there is some evidence suggesting that greater optimism is negatively associated with alcohol use (Wray et al., 2013), this evidence is mixed, with some studies finding that greater optimism is associated with higher alcohol intake (Giltay et al., 2007; Steptoe et al., 2006; Ylostalo et al., 2003). One explanation of this finding is that greater dispositional optimism was associated with a lower likelihood of developing negative affect during the pandemic, which may have in turn helped mitigate risk of chronic probable AUD according to the motivational models of addiction (Baker et al., 2004; Cooper et al., 1995).

Some studies on alcohol consumption in the general population have found that those who were younger were more likely to use more alcohol (Horigian et al., 2020; Pollard et al., 2020) and experience greater severity of psychiatric symptoms during the pandemic (Vahia et al., 2020). Our results accord with these findings, as younger age was associated with higher risk of both incident and chronic probable AUD during the pandemic. Similarly, higher pandemic-related worries have been linked to pandemic-related psychiatric symptoms (e.g., depression, anxiety), both of which are risk factors for SUD (Bendau et al., 2021). In this study, COVID-related stressors, most notably worries about family members and friends becoming infected, financial consequences of the pandemic, and how the pandemic will affect one's physical health, were associated with higher risk of probable AUD. These findings align with the affective processing model of negative reinforcement, which posits that escape and avoidance of negative affect is a strong motivation of alcohol use (Baker et al., 2004) and suggest that the development and maintenance of probable AUD during the pandemic may be driven in part by avoidance of and/or escape from pandemic-related worries. It is also possible that veterans who maintained or developed probable AUD during the pandemic are more vulnerable to the stressors brought on by the pandemic. Notably, higher pre-pandemic annual household income was associated with lower risk of development of probable AUD during the pandemic, suggesting that veterans with lower pre-pandemic socioeconomic resources may have experienced more distress from the

Table 1
 Characteristics of U.S. veterans by pre- and 1-year peri-pandemic probable AUD status.

	No AUD N = 2709 (87.2 %)	Incident probable AUD N = 71 (2.7 %)	Remitted probable AUD N = 85 (3.2 %)	Chronic probable AUD N = 183 (6.9 %)	Incident probable AUD vs. No AUD <i>p</i>	Chronic probable AUD vs. No AUD <i>p</i>	Chronic probable AUD vs. Remitted probable AUD <i>p</i>
	Weighted Mean (SEM) or N (Weighted%)	Weighted Mean (SEM) or N (Weighted%)	Weighted Mean (SEM) or N (Weighted%)	Weighted Mean (SEM) or N (Weighted%)			
Age	64.1 (14.5)	56.3 (14.1)	60.8 (14.1)	55.8 (14.3)	<0.001	<0.001	<0.01
Male gender	2394 (91.2)	67 (95.1)	79 (94.7)	167 (94.1)	0.22	0.14	0.85
White race/ethnicity	2239 (79.1)	60 (80.0)	72 (83.0)	149 (80.0)	0.85	0.77	0.54
College graduate or higher education	1250 (34.4)	24 (21.3)	39 (38.3)	81 (35.6)	0.02	0.72	0.65
Married/partnered	1962 (74.4)	49 (65.0)	62 (80.9)	130 (68.8)	0.06	0.08	0.03
Household income \$60 K or higher	1629 (61.1)	40 (51.3)	51 (57.9)	114 (60.8)	0.08	0.94	0.64
Combat veteran	906 (34.5)	24 (37.5)	25 (30.5)	85 (47.5)	0.58	<0.001	<0.01
Pre-pandemic risk factors							
Sum of lifetime traumas	8.7 (8.2)	10.0 (8.4)	10.4 (10.2)	10.2 (8.1)	0.17	0.02	0.83
Adverse childhood experiences	1.4 (0.0)	1.3 (0.1)	1.8 (0.2)	2.4 (0.2)	0.61	<0.001	0.03
Lifetime MDD or PTSD	482 (19.8)	18 (30.3)	23 (33.7)	61 (40.6)	0.03	<0.001	0.27
Lifetime AUD or DUD	995 (37.5)	50 (75.0)	61 (75.8)	61 (75.8)	<0.001	<0.001	0.06
Psychiatric symptom severity	-0.1 (0.8)	0.1 (0.8)	0.3 (1.1)	0.5 (1.1)	0.07	<0.001	0.21
Alcohol use problem severity	1.9 (1.9)	5.3 (2.0)	10.3 (3.1)	15.1 (6.9)	<0.001	<0.001	<0.001
Non-prescription drug use days	11.5 (1.1)	27.7 (9.2)	4.6 (3.1)	47.9 (8.0)	0.09	<0.001	<0.001
Number of medical conditions	3.0 (2.2)	2.8 (2.2)	2.8 (1.9)	2.8 (2.0)	0.53	0.19	0.81
Loneliness	4.5 (1.8)	4.9 (1.4)	4.9 (1.9)	5.2 (2.0)	<0.01	<0.001	0.13
Pre-pandemic protective factors							
Social support	19.0 (5.0)	17.4 (5.0)	17.1 (5.8)	17.7 (5.5)	<0.01	<0.001	0.40
Protective psychosocial characteristics	0.1 (0.9)	-0.2 (1.0)	-0.0 (1.0)	0.4 (1.2)	<0.01	<0.001	0.49
Pandemic-related variables							
Infected with COVID-19	189 (7.6)	6 (11.3)	11 (9.7)	24 (13.2)	0.23	<0.01	0.38
Know someone who died of COVID-19	155 (5.6)	3 (7.5)	5 (6.3)	11 (5.4)	0.46	0.90	0.74
Hours consume COVID-related media per week	1.6 (0.0)	1.9 (0.2)	1.8 (0.2)	1.7 (0.2)	0.02	0.35	0.79
Positive screen for COVID-related PTSD symptoms	322 (11.7)	13 (19.8)	13 (18.1)	42 (21.1)	0.03	<0.001	0.55
COVID-related worries	-0.03 (1.0)	0.2 (0.8)	0.12 (1.1)	0.2 (1.0)	0.01	<0.01	0.56
COVID-related social restriction stress	-0.03 (1.0)	0.02 (0.7)	0.5 (1.1)	0.2 (1.2)	0.53	<0.01	0.10
COVID-related financial stress	-0.02 (1.0)	0.3 (1.3)	0.2 (1.2)	-0.02 (1.1)	0.02	0.99	0.15
COVID-related worsening relationships	-0.02 (1.0)	0.3 (0.8)	0.01 (1.0)	0.03 (1.1)	0.01	0.57	0.89
Change variables							
Social support	-0.3 (4.4)	-0.1 (4.3)	0.5 (5.2)	0.1 (4.3)	0.72	0.23	0.46
Protective psychosocial characteristics	-0.03 (0.7)	-0.07 (0.7)	-0.05 (0.7)	0.04 (0.7)	0.61	0.16	0.33
Loneliness	-0.9 (1.3)	0.1 (1.4)	-0.4 (1.4)	-0.03 (1.3)	0.12	0.48	0.06

AUD = alcohol use disorder, COVID = coronavirus disease, DUD = drug use disorder, MDD = major depressive disorder, PTSD = posttraumatic stress disorder, SEM = standard error of the mean, SD = standard deviation.

Table 2
Multivariable regression models predicting probable AUD status over 1-year study period.

Incident probable AUD (N = 71) vs No AUD (N = 2709) (Model R ² = 0.35)			
Variables	OR (95 % CI)	Wald	p
Age	0.97 (0.95–0.99)	10.7	0.001
Married/Partnered	1.26 (0.67–2.38)	0.52	0.47
College graduate	0.76 (0.41–1.41)	0.76	0.38
Household Income 60k +	0.39 (0.22–0.69)	10.4	<0.01
AUDIT sum	2.38 (2.06–2.75)	136.5	<0.001
Psychiatric symptom severity	0.99 (0.68–1.43)	0.003	0.95
Loneliness	0.86 (0.71–1.06)	1.98	0.16
Social support	0.96 (0.89–1.02)	1.90	0.17
Protective psychosocial factor	0.89 (0.63–1.26)	0.45	0.51
COVID-related worries	1.52 (1.16–1.99)	9.46	<0.01
COVID-financial living difficulties	1.40 (1.12–1.75)	8.85	<0.01
COVID-related worsening of quality of relationships	1.38 (1.06–1.81)	5.56	0.02
Chronic probable AUD (N = 183) vs No AUD (N = 2709) (Model R ² = 0.21)			
Variables	OR (95 % CI)	Wald	P
Age	0.97 (0.96–0.99)	14.6	<0.001
Combat veteran	1.78 (1.26–2.51)	10.5	0.001
Total lifetime traumas	0.99 (0.97–1.01)	0.96	0.33
Adverse childhood experiences	1.01 (0.92–1.10)	0.02	0.89
Lifetime MDD and/or PTSD	0.85 (0.54–1.36)	0.45	0.50
Lifetime AUD and/or DUD	8.77 (5.42–14.18)	78.4	<0.001
Psychiatric symptom severity	1.03 (0.80–1.32)	0.04	0.83
Non-prescription drug use days past year	1.01 (1.01–1.02)	7.52	<0.01
Loneliness	0.94 (0.83–1.07)	0.76	0.38
Social support	1.01 (0.97–1.05)	0.12	0.73
Protective psychosocial characteristics	0.76 (0.61–0.94)	6.59	0.01
Infected with COVID-19	1.06 (0.61–1.85)	0.05	0.83
Positive screen for COVID-related stress symptoms	1.04 (0.63–1.70)	0.02	0.89
COVID-related worries	1.24 (1.03–1.49)	5.44	0.02
COVID-related social restriction stress	1.26 (1.06–1.50)	7.04	<0.01
Chronic probable AUD (N = 183) vs Remitted probable AUD (N = 85) (Model R ² = 0.33)			
Variables	OR (95 % CI)	Wald	P
Age	0.99 (0.97–1.02)	0.29	0.59
Married/partnered	0.61 (0.30–1.22)	1.96	0.16
Combat veteran	3.16 (1.72–5.81)	13.8	<0.001
Adverse childhood experiences	0.91 (0.78–1.05)	1.60	0.20
AUDIT sum	1.26 (1.15–1.38)	25.1	<0.001
Non-prescription drug use days past year	1.01 (1.01–1.02)	4.52	0.03

AUD = alcohol use disorder, AUDIT = alcohol use disorders identification test, CI = confidence intervals, COVID = corona virus disease, DUD = drug use disorder, MDD = major depressive disorder, OR = odds ratio, PTSD = post-traumatic stress disorder.

impact of the pandemic (Hobfoll, 1991), which may in turn have contributed to the development of probable AUD.

Having chronic probable AUD may also be associated with increased risk of infection to COVID-19. Previous studies have suggested that alcohol consumption reduces immunity, which significantly increases the risk of infection (Chick, 2020). Further, alcohol consumption has been acknowledged as a possible risk factor for increased COVID-19 severity and intensive care unit admissions (Udomsak et al., 2021). In this study, veterans with chronic probable AUD were more likely to have

been infected with COVID-19 than those who screened negative for AUD (13.2 % vs. 7.6 %). While this difference was not significant when considered in the context of other variables, veterans with chronic probable AUD were more likely to report having greater difficulty following recommendations for keeping away from close contact with others, which may have increased their risk of viral exposure. Given that AUD is linked to propensity for risk taking and externalizing behaviors (Deeken et al., 2020; Finkel and Hall, 2018), further research is needed to understand the role of such factors in increasing risk for viral exposure and transmission during the pandemic.

This study has several limitations. First, given that the majority of our sample was comprised of male veterans, and to emphasize specificity over sensitivity in identifying probable AUD, we utilized the commonly used cut score of 8+ to identify probable AUD on the AUDIT. Given that lower cutoff scores on the AUDIT have been recommended to maximize sensitivity of detecting probable AUD in women (Bradley et al., 1998), further research with larger samples of female veterans are needed to examine pandemic-related changes in the course of AUD using such thresholds. Second, due to the survey design of this study, we used a screening instrument to assess probable AUD instead of structured clinical interviews. Further research using diagnostic instruments is needed to replicate the results reported herein. Third, while nationally representative, our sample was comprised predominantly of older, male, and white veterans, which makes it difficult to generalize results to more diverse samples of veterans, as well as non-veteran populations. Fourth, although this was a prospective cohort study, given the cross-sectional nature of the surveys, it is difficult to draw causal conclusions regarding factors associated with incident and chronic probable AUD.

Despite these limitations, results of this study provide the first known population-based characterization of the prevalence, risk and protective factors associated with longitudinal courses of probable AUD in the COVID-19 pandemic. Collectively, our findings indicate that younger age, combat exposure, greater COVID-related stressors, and less pre-pandemic socioeconomic resources and lower dispositional optimism are associated with higher risk of probable AUD during the pandemic. Veterans with these characteristics may thus deserve close clinical attention and monitoring, as well as supportive resources. Measures assessing COVID-related stressors (e.g., the Coronavirus Health Impact Survey) may be considered as additional assessment tools when gauging AUD risk in veterans and other at-risk populations. Our finding that higher household income was associated with lower risk of developing probable AUD during the pandemic underscores the importance of policy efforts to mitigate financial distress during the pandemic in veterans at heightened risk for AUD. Further research is needed to replicate these results in other samples; identify more proximate and evolving risk and protective factors for AUD; and evaluate the efficacy of prevention and treatment efforts targeting empirically-supported factors in mitigating AUD risk in veterans and other high-risk populations.

Author contribution

Peter J. Na assisted with the study conceptualization and design, and writing of the paper. Melanie L. Hill, Brandon Nichter, and Sonya B. Norman collaborated in the literature review, writing and editing of the manuscript. Mark I. Rosen and Ismene L. Petrakis collaborated in the writing and editing of the manuscript. Robert H. Pietrzak designed the study, analyzed the data, and collaborated in the writing and editing of the manuscript.

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Declaration of Competing Interest

Dr. Petrakis provided consultation for Alkermes, Inc. Drs. Na, Norman, Nichter, Hill, Rosen, and Pietrzak report no competing interests.

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