1

6

7

8   **Corresponding author mail id: mstein@ucsd.edu**

9   **Alcohol Misuse and Co-Occurring Mental Disorders**

10   **Among New Soldiers in the U.S. Army**

11

12   Murray B. Stein MD, MPH

13   Laura Campbell-Sills, PhD

14   Joel Gelernter, MD

15   Feng He, MS

16   Steven G. Heeringa, PhD

17   Matthew J. Nock, PhD

18   Nancy A. Sampson, BA

19   Xiaoying Sun, MS

20   Sonia Jain, PhD

21   Ronald C. Kessler, PhD

22   Robert J. Ursano, MD

23   On behalf of the Army STARRS collaborators

24

25

27

28

29   September 16, 2016

30

31

32

33   **ABSTRACT**

34   **BACKGROUND:** Problem drinking that predates enlistment into military service may contribute to the

35   overall burden of alcohol misuse in the Armed Forces; however, evidence bearing on this issue is limited.

36   The current study examines prevalence and correlates of alcohol misuse among new US Army soldiers.

37   **METHODS:** Cross-sectional survey data were collected from soldiers reporting for basic combat training.

38   The survey retrospectively assessed lifetime alcohol consumption and substance abuse/dependence,

39   enabling estimation of the prevalence of lifetime binge drinking and heavy drinking in a sample of

40   30,583 soldiers and of probable alcohol use disorder (AUD) among 26,754 soldiers with no/minimal

41   lifetime use of other drugs. Co-occurrence of mental disorders and other adverse outcomes with binge

42   drinking, heavy drinking, and AUD was examined. Discrete-time survival analysis, with person-year the

43   unit of analysis and a logistic link function, was used to estimate associations of AUD with subsequent

44   onset of mental disorders and vice versa.

45   **RESULTS:** Weighted prevalence of lifetime binge drinking was 27.2% (SE=0.4%) among males and 18.9%

46   (SE=0.7%) among females; respective estimates for heavy drinking were 13.9% (SE=0.3%) and 9.4%

47   (SE=0.4%). Among soldiers with no/minimal drug use, 9.5% (SE=0.2%) of males and 7.2% (SE=0.5%) of

48   females had lifetime AUD. Relative to no alcohol misuse, binge drinking, heavy drinking, and AUD were

49   associated with increased odds of all adverse outcomes under consideration [adjusted odds ratios

50   (AORs)=1.5 to 4.6; ps<.001]. Prior mental disorders and suicidal ideation were associated with onset of

51 AUD (AORs=2.3 to 2.8; *p*s<.001); and prior AUD was associated with onset of mental disorders and

52 suicidal ideation (AORs=2.0 to 3.2, *p*s<0.005).

53 **CONCLUSIONS:** Strong bidirectional associations between alcohol misuse and mental disorders were

54 observed in a cohort of soldiers beginning Army service. Conjoint recognition of alcohol misuse and

55 mental disorders upon enlistment may provide opportunities for risk mitigation early in a soldier's

56 career.

57   **Introduction**

58   Alcohol use disorders (AUDs) are prevalent and impactful in the United States and worldwide,

59 contributing markedly to the global burden of disease (Whiteford et al., 2013). The National

60 Epidemiologic Survey on Alcohol and Related Conditions III (NESARC-III), which surveyed a nationally

61 representative sample of non-institutionalized civilian adults, has documented the high prevalence and

62 morbidity associated with AUDs in the United States (Grant et al., 2015).

63   Alcohol misuse and AUDs are also prevalent among US military personnel. One-fifth of military

64 personnel were classified as heavy drinkers (consuming 5 or more drinks once a week or more) in a

65 recent survey representing the total active force (Mattiko et al., 2011). Population-based health

66 behavior surveys of active duty personnel administered by the US Department of Defense (DoD)

67 revealed significant increases in binge drinking (35% to 47%) and heavy drinking (15% to 20%) from

68 1998-2008 that were highest among those with combat exposure (Bray et al., 2013). A study of mental

69 disorders in a representative sample of 671 Ohio Army National Guard members found that AUD was

70 the most common lifetime disorder, with a prevalence of 44% (Fink et al., 2016a). U.S. military veterans

71 also have a high prevalence (42%) of lifetime AUD (Fuehrlein et al., 2016).

72   Alcohol misuse profoundly impacts servicemembers' individual health and well-being (Waller et

73 al., 2015). In the aforementioned survey of US military personnel representing the total active force, a

74 dose-response relationship was observed between drinking level and serious consequences such as

75 accidents and injuries; and occupational, relational, and legal problems related to alcohol use (Mattiko

76 et al., 2011). Heavy drinking was associated with a particularly marked increase in these adverse

77 consequences. Heavy drinking also has been found to be associated with increased risk for suicidal

78 behaviors among Army soldiers (Mash et al., 2014). Similarly, AUDs were associated with increases over

79 time in depressive and posttraumatic stress symptoms among Ohio National Guard members (Sampson

80 et al., 2015). Beyond impacts on individual health and functioning, alcohol misuse burdens the Armed

81 Forces as an organization, with dose-response relationships observed between level of drinking and

82 productivity loss (Mattiko et al., 2011).

83   These observations underscore the importance of gaining a contemporary, population-based

84 perspective on the extent of alcohol use problems and concomitant adverse outcomes among US

85 military personnel. Estimates derived from the overall active force are informative and actionable;

86 however, they leave unanswered questions regarding potential contributors to the burden of alcohol

87 misuse in the military (e.g., relative roles of selection factors versus experiences related to military

88 service). What is also needed is information pertaining to pre-enlistment experiences and conditions

89 that may shape the mental health needs of servicemembers as they integrate into military culture and

90 encounter military-specific exposures such as deployment.

91   Available evidence suggests that mental disorders in general – and substance use problems in

92 particular – commonly emerge prior to servicemembers' enlistment in the Armed Forces. An analysis

93 from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS) found that

94 approximately 38% of soldiers with 30-day Substance Use Disorder (SUD; due to alcohol and/or drug

95 misuse) reported onset prior to their enlistment in the US Army (Kessler et al., 2014). More than 40% of

96 Ohio National Guard members with lifetime AUD reported onset of the disorder prior to enlistment

97 (Fink et al., 2016a). These studies established pre-enlistment onset via retrospective self-report. In

98 contrast, a report from the Army STARRS New Soldier Study (NSS; also the basis for the current analysis)

99 estimated prevalence of lifetime SUD (due to alcohol and/or drug use) among new soldiers just starting

100 basic combat training (Rosellini et al., 2015). Lifetime prevalence of SUD in these incoming soldiers was

101 12.6%, which although substantial did not differ significantly from the prevalence (13.9%) observed in a

102 demographically-matched civilian sample. Another survey of US Navy recruits during 2011-2014 found

103 that approximately 40% of those aged 21 and older had engaged in risky drinking prior to beginning

104 their Navy service (Derefinko et al., 2016). Rates were even higher among younger recruits (<21 years

105 old), with more than half endorsing risky drinking and approximately 10% endorsing harmful/hazardous

106 drinking prior to beginning their military service.

107   The present study provides a novel perspective on the burden of alcohol misuse in the military

108 by examining the prevalence and correlates of lifetime alcohol misuse among soldiers entering the US

109 Army. We build on prior investigations of this Army STARRS sample (Rosellini et al., 2015) by focusing

110 specifically on problem drinking (versus SUD) and by examining the full spectrum of alcohol misuse. We

111 estimate the prevalence of lifetime binge drinking and heavy drinking in a representative sample of new

112 Army soldiers, as well as lifetime and 12-month AUD in a subsample with no or minimal lifetime use of

113 other drugs. We also extend prior research by examining prevalence of mental disorders and other

114 adverse outcomes among subgroups of soldiers with histories of binge drinking, heavy drinking, and

115 AUD. Finally, to improve understanding of the nature of associations between alcohol misuse and

116 mental disorders, we utilize age-of-onset data to determine whether AUD is associated with increased

117 risk of subsequent mental disorders, and conversely whether certain mental disorders are associated

118 with increased risk of onset of AUD. These association analyses may elucidate other vulnerabilities and

119 mental health needs of soldiers with pre-enlistment histories of alcohol misuse; and provide information

120 about risk factors for onset of AUD in this population.

121 **Materials and Methods**

122 *Participants and Procedures*

123 Prior reports describe the design and methodology of Army STARRS (Kessler et al., 2013a,

124 Ursano et al., 2014). The New Soldier Survey (NSS) component was administered at three basic training

125 installations during the period of April 2011 to November 2012. Soldiers reporting for Basic Combat

126 Training were surveyed while completing intake procedures. Representative samples of 200-300

127 soldiers per site were selected on a weekly basis to attend a 30-minute informed consent session that

128 covered the study's purposes, procedures, and protections against breach of confidentiality. Nearly all

129 (99.9%) selected soldiers consented to the self-administered questionnaire (SAQ), and 93.5% of those

130 who consented completed the full SAQ. Incomplete SAQs were mainly due to time constraints (e.g.,

131 cohorts arriving late or having to leave early). Of soldiers who completed the SAQ, 77.1% consented to

132 linkage of responses to their Army/DoD administrative records. Recruitment, consent, and data

133 protection procedures were approved by the Human Subjects Committees of all collaborating

134 institutions.

135 As in prior NSS studies (Ursano et al., 2015, Rosellini et al., 2015, Nock et al., 2015), the sample

136 was constrained to respondents whose complete SAQ data were successfully linked to their Army/DoD

137 Administrative records (*n*=38,507). Analyses incorporate a combined analysis weight that adjusts for

138 differential administrative record linkage consent among SAQ completers and includes a post-

139 stratification of these consent weights to known demographics and service traits of the population of

140 soldiers attending Basic Combat Training during the study period. A description of NSS clustering and

141 weighting is available in a previous report devoted to those topics (Kessler et al., 2013b).

142   For this investigation of alcohol misuse, additional sample restriction was necessary (**Figure 1**)

143   because the item assessing consumption of 5 or more alcoholic drinks in one day (i.e., alcohol binges;

144   used to derive binge drinking and heavy drinking variables) was added to the NSS survey partway into

145   data collection. Analyses are therefore based on data from participants in the third and fourth (of 4

146   total) NSS administrations (*n*=30,583). We report prevalence of lifetime binge drinking, heavy drinking,

147   and non-alcohol substance use among these respondents, who for the purposes of this report are

148   referred to as the "overall sample".

149   The current study aimed to examine the full range of alcohol misuse including Alcohol Use

150   Disorder (AUD); however, the NSS survey did not discriminate between substance use disorder

151   symptoms resulting from alcohol versus other substance use. We therefore conducted analyses of the

152   prevalence and correlates of probable Alcohol Use Disorder (AUD) in a subsample that conservatively

153   excluded respondents who endorsed lifetime use of non-alcohol substances at a frequency of "1-3 times

154   per month" or greater. The subsample of soldiers with no or minimal use of non-alcohol substances

155   (*n*=26,754) is henceforth called the "restricted sample."

156   *Measures*

157   *Binge Drinking and Heavy Drinking*. Items assessing frequency of alcohol use were adapted

158   from the Composite International Diagnostic Interview (CIDI)(Kessler and Ustun, 2004) for use in Army

159   STARRS. Respondents rated frequency of any alcohol use (1 or more drinks) and of alcohol binges (5 or

160   more drinks). Respondents rated frequency of use for "the times when you used each…substance most

161   often," using the categories "never," "less than once a month," "1-3 days a month," "1-2 days a week,"

162   "3-4 days a week," or "every or nearly every day" (coded 0-5 for analysis). The Substance Abuse and

163   Mental Health Services Administration (SAMHSA) definition of binge drinking is "drinking 5 or more

164   alcoholic drinks on the same occasion on at least 1 day in the past 30 days". Thus, ratings $\geq$2 ("1-3 days

165   a month") for drinking 5 or more alcoholic drinks were considered positive for lifetime Binge Drinking.

166   The SAMHSA definition of heavy drinking is "drinking 5 or more drinks on the same occasion on each of

167   5 or more days in the past 30 days." Therefore, ratings $\geq$3 ("1-2 days a week") for drinking 5 or more

168   alcoholic drinks were considered positive for lifetime Heavy Drinking.

169   *Other (Non-Alcohol) Substance Use.* Survey items also assessed peak lifetime frequency of use

170   of marijuana/hashish; spice (e.g., K2, plant food, fake weed); any other illegal drug (e.g., cocaine,

171   ecstasy, speed, LSD, poppers); prescription stimulants (e.g., Adderall, diet pills, amphetamines);

172   prescription tranquilizers or muscle relaxers (e.g., Ativan, Valium) or sedatives (e.g., Ambien, Quaalude);

173   and prescription pain relievers (e.g., codeine, OxyContin). Items assessing the final three substance

174 types specified that respondents should rate use that occurred "without a doctor's prescription or more

175 than prescribed or to get high, buzzed, or numbed out." Nicotine use also was assessed but will be the

176 focus of a separate report. Respondents indicated whether they had used each substance "never," "less

177 than once a month," "1-3 days a month," "1-2 days a week," "3-4 days a week," or "every or nearly

178 every day" (coded 0-5 for analysis). Ratings $\geq$2 ("1-3 days a month") were considered positive for

179 estimating lifetime prevalence of non-alcohol substance use in the overall sample.

180 *Probable Alcohol Use Disorder (AUD)*. Diagnosis of SUD was based on self-administered CIDI

181 Screening Scales (CIDI-SC)(Kessler et al., 2013c). Respondents who endorsed any substance use were

182 asked to think about the period of their lives when they used the most alcohol (for those with no

183 lifetime use of other drugs), drugs (for those with no lifetime use of alcohol), or alcohol or drugs (for

184 those with lifetime alcohol and other drug use). Respondents then rated frequency of problems related

185 to substance use as "never," "less than once a month," "1-3 days a month," "1-2 days a week," "3-4 days

186 a week," or "every or nearly every day." Problems related to substance use that were assessed in the

187 NSS were: interference with work, school, or home responsibilities; interpersonal problems; use in

188 situations that could be dangerous to self or others (e.g., when driving or using a weapon); lack of

189 control over use; problems with law enforcement; concern about being unable to use in certain

190 situations; worrying about level of use; feeling a need to cut down or stop use; feeling guilty about use;

191 and needing an eye-opener to relieve withdrawal symptoms. An algorithm that employed respondents'

192 ratings of these items was used to diagnose lifetime SUD, and the diagnosis was validated against

193 structured clinical interviews in a clinical calibration study (Kessler et al., 2013c).

194 SUD data from respondents whose lifetime use of non-alcohol drugs was "never" or "less than

195 once a month" were considered in this study. Given the absence/rarity of non-alcohol drug use in this

196 restricted sample, we inferred that SUD items had been rated in reference to alcohol use and labeled

197 cases of lifetime SUD as "probable lifetime AUD". To establish past-year AUD, we used a survey item

198 that inquired how many months out of the past 12 respondents had these types of problems related to

199 their substance use. Responses $\geq$1 month were coded positive for probable past-year AUD. Age-of-

200 onset was assessed with an item inquiring how old the respondent was the first time he or she had the

201 reported problems related to substance use. Age-of-onset was used to establish the temporal

202 relationship of AUD to other diagnoses.

203 *Co-occurring mental disorders*. Associations of alcohol misuse with mental disorders were

204 examined. Diagnoses were established using the CIDI-SC and Posttraumatic Stress Disorder (PTSD)

205 Checklist, and validated in a prior study (Kessler et al., 2013c). Mental disorders under consideration for

206   this report were lifetime and past 30-day PTSD, major depressive episode (MDE), generalized anxiety

207   disorder (GAD), and panic disorder (PD); and lifetime mania/hypomania. Ages of onset were assessed

208   and used to determine temporal relationships of these conditions with AUD.

209   *Other co-occurring adverse outcomes.* Suicidal ideation was assessed using a modified version

210   of the Columbia Suicidal Severity Rating Scale (Posner et al., 2011). Co-occurrence of alcohol misuse

211   with lifetime and past 30-day suicidal ideation was considered. Probable lifetime traumatic brain injury

212   (TBI) was assessed and defined as endorsing any lifetime head, neck, or blast injury that was associated

213   with loss or alteration of consciousness or memory lapse (Stein et al., 2015). Finally, the NSS assessed

214   occurrence of (1) any past-year motor vehicle accidents (MVAs) while the respondent was driving, and

215   (2) any past-year MVAs that caused injury or property damage for which the respondent was at fault;

216   these outcomes also were examined in relation to alcohol misuse.

217   *Socio-demographic and Army service variables.* Models of associations between AUD and PTSD,

218   MDE, GAD, PD, mania/hypomania, and suicidal ideation adjusted for time-varying person-year and

219   education and time-invariant sex, race-ethnicity, religion at the time of the interview, marital status at

220   the time of the interview, parental education, and nativity. All models also adjusted for Army service

221   component (Regular Army, National Guard, or Army Reserve) and site of Basic Combat Training.

222

223

224   *Data Analysis*

225   Weighted prevalence of lifetime binge drinking, heavy drinking, and non-alcohol substance use

226   was calculated in the overall sample (*N*=30,583). Weighted prevalence of lifetime binge drinking,

227   lifetime heavy drinking, lifetime probable AUD, and probable past-year AUD were calculated in the

228   restricted sample of respondents with no or minimal non-alcohol drug use (*n*=26,754). Missing data

229   were rare ($\leq$1.8%) and left missing in the analyses. Pearson's X^2 was used to test for sex differences in

230   the prevalence of alcohol misuse. Supplementary analyses also used Pearson's X^2 to evaluate

231   differences by race/ethnicity (White, Black, Hispanic, or Other), age group (18-20, 21-23, or 24 and

232   older), and Army service component (Regular Army, Army National Guard, or Army Reserve).

233   In the restricted sample, weights-adjusted logistic regression models were fit to estimate

234   associations of the different types of alcohol misuse (binge drinking, heavy drinking, probable lifetime

235   AUD, and probable past-year AUD) with mental disorders and other adverse outcomes, adjusting for

236   socio-demographic and Army service variables. Each alcohol misuse category was compared to the

237   reference group "No Lifetime Alcohol Misuse".

238   Age-of-onset data were used to create person-year datasets for discrete-time survival analysis

239   (Singer and Willett, 2003) of the associations of (1) temporally prior AUD with subsequent onset of

240   PTSD, MDE, GAD, PD, mania/hypomania, and suicidal ideation; and (2) temporally prior mental

241   disorders/ suicidal ideation with subsequent onset of AUD. The person-year file was limited to 12-33

242   years of age due to exceedingly low prevalence of AUD and mental disorders prior to age 12 and of

243   enlistment after age 33. All models adjusted for socio-demographic and Army service variables and

244   were fit using a logistic link function (Efron, 1988). Survival coefficients were exponentiated to create

245   odds ratios (ORs) with 95% confidence intervals; the interpretation of OR in the discrete time survival

246   models indicates the effect of a given predictor on the hazard. Because NSS data were clustered and

247   weighted, the design-based Taylor series linearization method was used to estimate standard errors.

248   Multivariable significance was examined using design-based Wald X^2 tests. Two-tailed p values <.05

249   were considered significant. All analyses were conducted using the software R Version 3.0.2 (R Core

250   Team, 2013) with the R library *survey* (Lumley, 2004, Lumley, 2012) to estimate the discrete-time

251   survival models.

252   **Results**

253   *Prevalence of Binge Drinking, Heavy Drinking, and Non-Alcohol Substance Use*

254   **Table 1** shows weighted lifetime prevalence of binge drinking, heavy drinking, and non-alcohol

255   substance use in the overall sample. Binge drinking [X^2(1)=165.96, p<.001] and heavy drinking

256   [X^2(1)=84.37, p<.001] were substantially more prevalent among male than female soldiers. Male

257   soldiers also displayed higher prevalence of marijuana use [X^2(1)=8.69, p=.003] and synthetic marijuana

258   use [X^2(1)=12.72, p<.001]. **Supplementary Table 1** shows prevalence of binge drinking, heavy drinking,

259   and non-alcohol substance use by race/ethnicity, age group, and service component.   Substantive

260   differences included higher prevalence of binge drinking and heavy drinking among soldiers aged 21 and

261   older compared to those aged 18-20. Binge drinking and heavy drinking were also more prevalent

262   among White soldiers than among members of other race/ethnicity groups, with Black soldiers

263   displaying the lowest prevalence. Variation in the proportion of females across race/ethnicity groups

264   may contribute to these differences; among subgroups of soldiers identifying as White, Black, Hispanic,

265   and Other, the proportions of females were 12.1%, 26.9%, 17.9%, and 17.3%, respectively.

266   Remaining results are based on the restricted sample of respondents with no or minimal non-

267   alcohol drug use. **Table 2** shows weighted prevalence of lifetime binge drinking, lifetime heavy drinking,

268   probable lifetime AUD, and probable past-year AUD in the restricted sample. Each type of alcohol

269   misuse was less prevalent among women [X^2(1)=8.52 to 142.66, ps<.005]. **Supplementary Table 2**

270   provides prevalence of lifetime binge drinking, lifetime heavy drinking, probable lifetime AUD, and

271   probable past-year AUD by race/ethnicity, age group, and service component in the restricted sample.

272   Race/ethnicity and age group differences for binge drinking and heavy drinking were analogous to those

273   found in the overall sample, though in some cases less pronounced. Probable lifetime AUD was slightly

274   more prevalent among soldiers who identified their race as Other or White than among those who

275   identified as Hispanic or Black; and among those aged 21 and older.

276   *Co-occurrence of Alcohol Misuse with Mental Disorders and other Adverse Outcomes*

277   Relative to soldiers with no lifetime alcohol misuse, and adjusting for socio-demographic and

278   Army service variables, the prevalence of *all* adverse outcomes under consideration was significantly

279   higher among soldiers with lifetime binge drinking (AORs=1.53 for lifetime suicidal ideation to 2.08 for

280   lifetime PD; *p*s<.001), lifetime heavy drinking (AORs=1.67 for past-year MVA while driving to 2.61 for

281   lifetime mania/hypomania; *p*s<.001), probable lifetime AUD (AORs=1.74 for past-year MVA while driving

282   to 3.66 for past-month suicidal ideation; *p*s<.001), and probable past-year AUD (AORs=1.99 for past-year

283   MVA while driving to 4.55 for past-month suicidal ideation; *p*s<.001). See **Supplementary Table 3** for

284   full results of these association analyses.

285   **Figure 2** displays prevalence of selected conditions (lifetime PTSD, suicidal ideation, MDE, and

286   PD) by alcohol misuse category. As the figure illustrates, prevalence of adverse outcomes generally

287   increased in a dose-response fashion as severity of alcohol misuse increased.   The complete set of

288   comorbidity estimates is provided in **Supplementary Table 4**.

289   Among soldiers with probable lifetime AUD, prevalence of co-occurring lifetime mental

290   disorders ranged from 5.5% (SE=0.6%) for PD to 23.2% (SE=1.1%) for PTSD. Other highly prevalent

291   lifetime outcomes among those with probable lifetime AUD were TBI (64.3% vs. 39.4% of those with no

292   alcohol misuse) and suicidal ideation (23.4% vs. 10.2% of those with no alcohol misuse). Among soldiers

293   with probable past-year AUD, prevalence of co-occurring 30-day mental disorders ranged from 5.6%

294   (SE=0.7%) for PD to 20.2% (SE=1.3%) for PTSD.

295

296   *Associations of Mental Disorders and Suicidal Ideation with Onset of Probable Alcohol Use Disorder*

297   The first set of discrete time-survival models estimated associations of temporally prior PTSD,

298   MDE, GAD, PD, mania/hypomania and suicidal ideation with subsequent onset of probable AUD. After

299   adjusting for socio-demographic and Army service variables, each mental disorder was associated with

300   increased odds of subsequent AUD. Adjusted odds-ratios for the predictors of interest ranged from 2.31

301   for PTSD to 2.85 for mania/hypomania (**Table 3**).

302   *Associations of Probable Alcohol Use Disorder with Onset of Other Mental Disorders*

303   The second set of discrete time-survival models estimated associations of temporally prior AUD

304   with subsequent onset of other mental disorders/suicidal ideation. After adjusting for socio-

305   demographic and Army service variables, probable AUD was associated with increased odds of

306   subsequent PTSD, MDE, GAD, PD, mania/hypomania, and suicidal ideation. Adjusted odds-ratios for

307   AUD ranged from 1.98 for the outcome of suicidal ideation to 3.15 for the outcome of PTSD (**Table 4**).

308   **Discussion**

309   In this study of new soldiers reporting on their alcohol and substance use prior to entering the

310   military, we found that more than 1 in 4 men (27.2%) reported binge drinking and 1 in 7 reported heavy

311   drinking (13.9%); prevalence was lower in women (18.9% and 9.4%, respectively). With the exception of

312   lifetime marijuana use (reported by 8.7% of men and 7.6% of women), endorsement of other drug use

313   was below 4% for both males and females.

314   Prevalence and correlates of probable Alcohol Use Disorder (AUD) were estimated only among

315   soldiers with minimal lifetime use of non-alcohol drugs, a study limitation that is discussed below. Some

316   9.5% of male soldiers and 7.2% of female soldiers in this subgroup met criteria for probable lifetime

317   AUD; with 5.9% of males and 4.7% of females indicating that AUD symptoms were problematic during

318   the past year. The higher prevalence of all forms of alcohol misuse among male soldiers is consistent

319   with evidence from epidemiological surveys indicating that AUDs, binge drinking, and heavy drinking are

320   more common among men than women (Grant et al., 2015, Substance Abuse and Mental Health

321   Services Administration, 2014).

322   The limited available data on alcohol use of new military recruits suggest that the prevalence of

323   lifetime binge drinking observed in our sample of incoming Army soldiers is similar to that of Naval

324   recruits, 26% of whom endorsed "heavy drinking" – which was closest to our definition of Binge Drinking

325   – during the year prior to basic training (Ames et al., 2002). A somewhat higher prevalence was

326   observed in a study of Air Force recruits where 49% of the 78% of recruits who endorsed any alcohol use

327   (i.e., ~38% of the total sample) endorsed binge drinking (Taylor et al., 2007). To our knowledge, other

328   studies of military recruits have not estimated the prevalence of AUDs. However, the prevalence of

329   probable past-year AUD in our restricted sample (5.7%) is similar to that observed in a recent study of

330   Canadian Regular Military Forces Personnel (4.5%) (Rusu et al., 2016).

331   US-representative data from the National Epidemiologic Survey on Alcohol and Related

332   Conditions III (NESARC-III) indicate that the prevalence of lifetime and 12-month AUDs among 18- to 29-

333   year olds is 37% and 27%, respectively (Grant et al., 2015), much higher than the respective estimates

334   from our sample of new soldiers. This seems to indicate that the US Army's efforts to screen out

335   individuals with AUD are, to some extent, successful. However, it should be noted that the NESARC-III

336   comparison is not completely apt, as our estimates of AUD derive from a subsample of new soldiers with

337   no or minimal lifetime use of other drugs. Other important differences between the two studies include

338   the predominance of respondents from the younger end of the 18-29 age spectrum in our sample and

339   differences in the setting (household vs. site of Army basic combat training) and modality (self-

340   administered questionnaire vs. face-to-face interview) of assessment.

341   Irrespective of the above issues, our findings suggest that 1 of 8 soldiers enter Army service with

342   a history of heavy drinking and – even among those with minimal lifetime drug use – 1 in 11 enter with

343   probable lifetime AUD. This implies that the US army "inherits" an appreciable portion of its overall

344   burden of alcohol misuse. However, the literature strongly suggests that more alcohol misuse emerges

345   as soldiers progress in their careers. Data from the All-Army Study component of Army STARRS

346   indicated that the majority of soldiers with 30-day SUD had post-enlistment onset (Kessler et al., 2014).

347   Substantially higher prevalence of lifetime AUD is observed in surveys that include more experienced

348   military personnel and veterans. AUDs were the most prevalent lifetime disorders among Ohio National

349   Guard members (44%)(Fink et al., 2016a) and Canadian Regular Force members (32%)(Pearson et al.,

350   2014). A contemporary survey of U.S. military veterans revealed that 42% had lifetime AUD and 15%

351   had past-year AUD (Fuehrlein et al., 2016). Finally, there is evidence that deployments are associated

352   with increased risk of new-onset AUDs (Jacobson et al., 2008). More prospective research on alcohol

353   misuse among servicemembers is needed, including studies evaluating the impact of deployment

354   stressors and other factors related to military experiences. We intend to study the longitudinal course of

355   alcohol misuse in future work with the the Army STARRS cohorts.

356   Our psychiatric comorbidity data are consistent with other studies showing a strong association

357   of PTSD with AUDs in US (Marshall et al., 2012) and UK (Head et al., 2016) military samples, and reveal

358   that this association is also observed among Army recruits. Further analysis provided evidence for a

359   bidirectional association between PTSD and AUD. Other studies of the temporal relationship of these

360   disorders have yielded similar findings (Nickerson et al., 2014, Smith et al., 2014), which have been

361   interpreted as supporting both "self-medication" and "substance-induced anxiety" models of PTSD and

362   substance use disorder comorbidity. The particularly strong association of AUD with subsequent PTSD

363   (AOR=3.15) in our analysis suggests assessment of alcohol misuse may be relevant to identifying soldiers

364   at increased risk for PTSD following traumas incurred during military service.

365   Psychiatric comorbidity of AUD is by no means limited to PTSD, and associations of similar

366   magnitude were observed between AUD and other anxiety disorders, mood disorders, and suicidal

367   ideation. These results converge with findings from the general US population, where AUDs display

368   considerable comorbidity with both PTSD and other mental disorders (Grant et al., 2015). Consistent

369   with recent findings in a sample of Ohio National Guard personnel (Fink et al., 2016b), we found that

370   AUDs preceded as well as followed the onset of mental disorders and suicidal ideation. Although not all

371   investigations have found bidirectional relationships between AUDs and mental disorders (Kuo et al.,

372   2006), overall the available evidence suggests that interventions for AUD may help reduce the burden of

373   other mental disorders, and vice versa. For patients with dual diagnosis, consideration should be given

374   to treating both problems simultaneously (Roberts et al., 2015). These patients may benefit from

375   management of comorbid conditions using disorder-specific psychotherapies with or without

376   pharmacotherapy. For example, the psychotherapy Seeking Safety combined with a selective serotonin

377   reuptake inihibtor yielded meaningful benefits for PTSD and AUD symptoms in veterans with both

378   conditions (Hien et al., 2015). Additional research is needed to demonstrate the impact of treatments

379   aimed not only at PTSD, but at the full range of comorbid mental disorders seen among military

380   personnel with AUDs.

381   Finally, several non-psychiatric adverse outcomes were included in the analysis to illustrate

382   other correlates of AUD that may have implications for screening and intervention. Among new Army

383   soldiers, all types of alcohol misuse under consideration were associated with lifetime TBI and past-year

384   MVAs. These findings are perhaps unsurprising given the known cognitive and motor effects of alcohol

385   intoxication and the clustering of health-risk behaviors (Meader et al., 2016). Alcohol misuse –

386   particularly heavy drinking – has previously been linked to serious adverse consequences (an outcome

387   that included injuries and accidents) in military personnel (Mattiko et al., 2011). These results convey

388   the broad impact of alcohol misuse and reinforce the importance of screening, prevention, and

389   intervention efforts.

390   The current results must be interpreted in light of several important limitations. Evaluation of

391   alcohol misuse, substance use, and mental disorders relied on retrospective self-report and is subject to

392   response and recall biases. Respondents may have under-reported alcohol use and mental disorder

393   symptoms, although this bias is typically reduced when confidential self-administration is employed as

394   the mode of assessment (Kessler et al., 2013b). For soldiers who endorsed lifetime use of alcohol and

395   other drugs, the survey did not establish whether reported abuse/dependence symptoms were due to

396   alcohol use, drug use, or a combination of the two. Thus we were limited to examining prevalence and

397   correlates of "probable AUD" among new soldiers with no or minimal lifetime use of other drugs. We

398   applied a conservative exclusion criterion (resulting in exclusion of 12.5% of the overall sample) to

399   increase confidence that cases of SUD remaining in the restricted sample were due entirely to alcohol

400   misuse. A consequential tradeoff is that individuals with polysubstance use disorders – and even AUD

401   accompanied by semi-regular use of other drugs – are not represented.

402   In summary, lifetime alcohol misuse is fairly common among new soldiers entering the US Army.

403   Alcohol misuse ranging from lifetime binge drinking to past-year AUD is associated with an array of

404   mental disorders and other adverse outcomes. Analyses incorporating age-of-onset indicate that AUDs

405   are associated with increased odds of onset of anxiety disorders, mood disorders, and suicidal ideation;

406   and, conversely, that these same problems are associated with subsequent onset of AUD. The

407   substantial associations of AUD with other mental health problems, which appear to be bidirectional in

408   nature, must be considered in assessment and treatment planning. These associations also suggest that

409   efforts to prevent alcohol misuse may decrease the future burden of not just AUD but other mental

410   disorders; similarly, mental health promotion efforts may reduce adverse impacts of alcohol misuse.

411   Conjoint recognition of problematic alcohol use and mental health problems upon a soldier's entry into

412   the military provides a tremendous opportunity for intervention and risk mitigation, early in a soldier's

413   military career.

414   **Funding and Disclosure**

454   Smoller, MD, ScD (Harvard Medical School); Amy Street, PhD (Boston University School of Medicine);

455   Michael L. Thomas, PhD (University of California San Diego); Leming Wang, MS (Uniformed Services

456   University of the Health Sciences); Christina L. Wassel, PhD (University of Pittsburgh); Simon Wessely,

457   FMedSci (King's College London); Christina L. Wryter, BA (Uniformed Services University of the Health

458   Sciences); Hongyan Wu, MPH (Uniformed Services University of the Health Sciences); LTC Gary H. Wynn,

459   MD (Uniformed Services University of the Health Sciences); and Alan M. Zaslavsky, PhD (Harvard

460   Medical School). Kerry Ressler MD, PhD (Emory University) chaired the Scientific Advisory Board.

References

AMES, G. M., CUNRADI, C. B. & MOORE, R. S. 2002. Alcohol, tobacco, and drug use among young adults prior to entering the military. *Prev Sci,* 3**,** 135-44.

BRAY, R. M., BROWN, J. M. & WILLIAMS, J. 2013. Trends in binge and heavy drinking, alcohol-related problems, and combat exposure in the U.S. military. *Subst Use Misuse,* 48**,** 799-810.

DEREFINKO, K. J., KLESGES, R. C., BURSAC, Z., LITTLE, M. A., HRYSHKO-MULLEN, A. & TALCOTT, G. W. 2016. Alcohol issues prior to training in the United States Air Force. *Addict Behav,* 58**,** 142-8.

EFRON, B. 1988. Logistic regression, survival analysis, and the Kaplan-Meier curve. *Journal of the American Statistical Association,* 83**,** 414-425.

FINK, D. S., CALABRESE, J. R., LIBERZON, I., TAMBURRINO, M. B., CHAN, P., COHEN, G. H., SAMPSON, L., REED, P. L., SHIRLEY, E., GOTO, T., D'ARCANGELO, N., FINE, T. & GALEA, S. 2016a. Retrospective age-of-onset and projected lifetime prevalence of psychiatric disorders among U.S. Army National Guard soldiers. *J Affect Disord,* 202**,** 171-7.

FINK, D. S., GALLAWAY, M. S., TAMBURRINO, M. B., LIBERZON, I., CHAN, P., COHEN, G. H., SAMPSON, L., SHIRLEY, E., GOTO, T., D'ARCANGELO, N., FINE, T., REED, P. L., CALABRESE, J. R. & GALEA, S. 2016b. Onset of Alcohol Use Disorders and Comorbid Psychiatric Disorders in a Military Cohort: Are there Critical Periods for Prevention of Alcohol Use Disorders? *Prev Sci,* 17**,** 347-56.

FUEHRLEIN, B. S., MOTA, N., ARIAS, A. J., TREVISAN, L. A., KACHADOURIAN, L. K., KRYSTAL, J. H., SOUTHWICK, S. M. & PIETRZAK, R. H. 2016. The burden of alcohol use disorders in US military veterans: results from the National Health and Resilience in Veterans Study. *Addiction,* 111**,** 1786-94.

GRANT, B. F., GOLDSTEIN, R. B., SAHA, T. D., CHOU, S. P., JUNG, J., ZHANG, H., PICKERING, R. P., RUAN, W. J., SMITH, S. M., HUANG, B. & HASIN, D. S. 2015. Epidemiology of DSM-5 Alcohol Use Disorder: Results From the National Epidemiologic Survey on Alcohol and Related Conditions III. *JAMA Psychiatry,* 72**,** 757-66.

HEAD, M., GOODWIN, L., DEBELL, F., GREENBERG, N., WESSELY, S. & FEAR, N. T. 2016. Post-traumatic stress disorder and alcohol misuse: comorbidity in UK military personnel. *Soc Psychiatry Psychiatr Epidemiol,* 51**,** 1171-80.

HIEN, D. A., LEVIN, F. R., RUGLASS, L. M., LOPEZ-CASTRO, T., PAPINI, S., HU, M. C., COHEN, L. R. & HERRON, A. 2015. Combining seeking safety with sertraline for PTSD and alcohol use disorders: A randomized controlled trial. *J Consult Clin Psychol,* 83**,** 359-69.

JACOBSON, I. G., RYAN, M. A., HOOPER, T. I., SMITH, T. C., AMOROSO, P. J., BOYKO, E. J., GACKSTETTER, G. D., WELLS, T. S. & BELL, N. S. 2008. Alcohol use and alcohol-related problems before and after military combat deployment. *JAMA,* 300**,** 663-75.

KESSLER, R. C., COLPE, L. J., FULLERTON, C. S., GEBLER, N., NAIFEH, J. A., NOCK, M. K., SAMPSON, N. A., SCHOENBAUM, M., ZASLAVSKY, A. M., STEIN, M. B., URSANO, R. J. & HEERINGA, S. G. 2013a. Design of the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Int J Methods Psychiatr Res,* 22**,** 267-75.

KESSLER, R. C., HEERINGA, S. G., COLPE, L. J., FULLERTON, C. S., GEBLER, N., HWANG, I., NAIFEH, J. A., NOCK, M. K., SAMPSON, N. A., SCHOENBAUM, M., ZASLAVSKY, A. M., STEIN, M. B. & URSANO, R. J. 2013b. Response bias, weighting adjustments, and design effects in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Int J Methods Psychiatr Res,* 22**,** 288-302.

KESSLER, R. C., HEERINGA, S. G., STEIN, M. B., COLPE, L. J., FULLERTON, C. S., HWANG, I., NAIFEH, J. A., NOCK, M. K., PETUKHOVA, M., SAMPSON, N. A., SCHOENBAUM, M., ZASLAVSKY, A. M., URSANO, R. J. & ARMY, S. C. 2014. Thirty-day prevalence of DSM-IV mental disorders among nondeployed soldiers in the US Army: results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *JAMA Psychiatry,* 71**,** 504-13.

KESSLER, R. C., SANTIAGO, P. N., COLPE, L. J., DEMPSEY, C. L., FIRST, M. B., HEERINGA, S. G., STEIN, M. B., FULLERTON, C. S., GRUBER, M. J., NAIFEH, J. A., NOCK, M. K., SAMPSON, N. A., SCHOENBAUM, M., ZASLAVSKY, A. M. & URSANO, R. J. 2013c. Clinical reappraisal of the Composite International Diagnostic Interview Screening Scales (CIDI-SC) in the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Int J Methods Psychiatr Res,* 22**,** 303-21.

KESSLER, R. C. & USTUN, T. B. 2004. The World Mental Health (WMH) Survey Initiative Version of the World Health Organization (WHO) Composite International Diagnostic Interview (CIDI). *Int J Methods Psychiatr Res,* 13**,** 93-121.

KUO, P. H., GARDNER, C. O., KENDLER, K. S. & PRESCOTT, C. A. 2006. The temporal relationship of the onsets of alcohol dependence and major depression: using a genetically informative study design. *Psychol Med,* 36**,** 1153-62.

LUMLEY, T. 2004. Analysis of complex survey samples. *Journal of Statistical Software,* 9**,** 1-19.

LUMLEY, T. 2012. survey: analysis of complex survey samples. *R package version 3.28-2.*

MARSHALL, B. D., PRESCOTT, M. R., LIBERZON, I., TAMBURRINO, M. B., CALABRESE, J. R. & GALEA, S. 2012. Coincident posttraumatic stress disorder and depression predict alcohol abuse during and after deployment among Army National Guard soldiers. *Drug Alcohol Depend,* 124**,** 193-9.

MASH, H. B., FULLERTON, C. S., RAMSAWH, H. J., NG, T. H., WANG, L., KESSLER, R. C., STEIN, M. B. & URSANO, R. J. 2014. Risk for suicidal behaviors associated with alcohol and energy drink use in the US Army. *Soc Psychiatry Psychiatr Epidemiol,* 49**,** 1379-87.

MATTIKO, M. J., OLMSTED, K. L., BROWN, J. M. & BRAY, R. M. 2011. Alcohol use and negative consequences among active duty military personnel. *Addict Behav,* 36**,** 608-14.

MEADER, N., KING, K., MOE-BYRNE, T., WRIGHT, K., GRAHAM, H., PETTICREW, M., POWER, C., WHITE, M. & SOWDEN, A. J. 2016. A systematic review on the clustering and co-occurrence of multiple risk behaviours. *BMC Public Health,* 16**,** 657.

NICKERSON, A., BARNES, J. B., CREAMER, M., FORBES, D., MCFARLANE, A. C., O'DONNELL, M., SILOVE, D., STEEL, Z. & BRYANT, R. A. 2014. The temporal relationship between posttraumatic stress disorder and problem alcohol use following traumatic injury. *J Abnorm Psychol,* 123**,** 821-34.

NOCK, M. K., URSANO, R. J., HEERINGA, S. G., STEIN, M. B., JAIN, S., RAMAN, R., SUN, X., CHIU, W. T., COLPE, L. J., FULLERTON, C. S., GILMAN, S. E., HWANG, I., NAIFEH, J. A., ROSELLINI, A. J., SAMPSON, N. A., SCHOENBAUM, M., ZASLAVSKY, A. M., KESSLER, R. C. & THE ARMY, S. C. 2015. Mental Disorders, Comorbidity, and Pre-enlistment Suicidal Behavior Among New Soldiers in the U.S. Army: Results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Suicide Life Threat Behav*.

PEARSON, C., ZAMORSKI, M. & JANZ, T. 2014. "Mental health of the Canadian Armed Forces" Health at a Glance. *Statistics Canada Catalogue.*

POSNER, K., BROWN, G. K., STANLEY, B., BRENT, D. A., YERSHOVA, K. V., OQUENDO, M. A., CURRIER, G. W., MELVIN, G. A., GREENHILL, L., SHEN, S. & MANN, J. J. 2011. The Columbia-Suicide Severity Rating Scale: initial validity and internal consistency findings from three multisite studies with adolescents and adults. *Am J Psychiatry,* 168**,** 1266-77.

R CORE TEAM 2013. R: A language and environment for statistical computing. Vienna, Austria: R Foundation for Statistical Computing.

ROBERTS, N. P., ROBERTS, P. A., JONES, N. & BISSON, J. I. 2015. Psychological interventions for post-traumatic stress disorder and comorbid substance use disorder: A systematic review and meta-analysis. *Clin Psychol Rev,* 38**,** 25-38.

ROSELLINI, A. J., HEERINGA, S. G., STEIN, M. B., URSANO, R. J., CHIU, W. T., COLPE, L. J., FULLERTON, C. S., GILMAN, S. E., HWANG, I., NAIFEH, J. A., NOCK, M. K., PETUKHOVA, M., SAMPSON, N. A., SCHOENBAUM, M., ZASLAVSKY, A. M. & KESSLER, R. C. 2015. Lifetime prevalence of DSM-IV

mental disorders among new soldiers in the U.S. Army: results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Depress Anxiety,* 32**,** 13-24.

RUSU, C., ZAMORSKI, M. A., BOULOS, D. & GARBER, B. G. 2016. Prevalence Comparison of Past-year Mental Disorders and Suicidal Behaviours in the Canadian Armed Forces and the Canadian General Population. *Can J Psychiatry,* 61**,** 46S-55S.

SAMPSON, L., COHEN, G. H., CALABRESE, J. R., FINK, D. S., TAMBURRINO, M., LIBERZON, I., CHAN, P. & GALEA, S. 2015. Mental Health Over Time in a Military Sample: The Impact of Alcohol Use Disorder on Trajectories of Psychopathology After Deployment. *J Trauma Stress,* 28**,** 547-55.

SINGER, J. D. & WILLETT, J. B. 2003. *Applied longitudinal data analysis : modeling change and event occurrence,* Oxford ; New York, Oxford University Press.

SMITH, T. C., LEARDMANN, C. A., SMITH, B., JACOBSON, I. G., MILLER, S. C., WELLS, T. S., BOYKO, E. J. & RYAN, M. A. 2014. Longitudinal assessment of mental disorders, smoking, and hazardous drinking among a population-based cohort of US service members. *J Addict Med,* 8**,** 271-81.

STEIN, M. B., KESSLER, R. C., HEERINGA, S. G., JAIN, S., CAMPBELL-SILLS, L., COLPE, L. J., FULLERTON, C. S., NOCK, M. K., SAMPSON, N. A., SCHOENBAUM, M., SUN, X., THOMAS, M. L., URSANO, R. J. & ARMY, S. C. 2015. Prospective longitudinal evaluation of the effect of deployment-acquired traumatic brain injury on posttraumatic stress and related disorders: results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Am J Psychiatry,* 172**,** 1101-11.

SUBSTANCE ABUSE AND MENTAL HEALTH SERVICES ADMINISTRATION. 2014. *National Survey on Drug Use and Health (NSDUH). Table 5.8B—Substance dependence or abuse in the past year among persons aged 18 or older, by demographic characteristics: Percentages, 2013 and 2014.* [Online]. Available: http://www.samhsa.gov/data/sites/default/files/NSDUH-DetTabs2014/NSDUH-DetTabs2014.htm#tab5-8b [Accessed September 12 2016].

TAYLOR, J. E., HADDOCK, K., POSTON, W. S. & TALCOTT, W. G. 2007. Relationship between patterns of alcohol use and negative alcohol-related outcomes among U.S. Air Force recruits. *Mil Med,* 172**,** 379-82.

URSANO, R. J., COLPE, L. J., HEERINGA, S. G., KESSLER, R. C., SCHOENBAUM, M., STEIN, M. B. & ARMY, S. C. 2014. The Army study to assess risk and resilience in servicemembers (Army STARRS). *Psychiatry,* 77**,** 107-19.

URSANO, R. J., HEERINGA, S. G., STEIN, M. B., JAIN, S., RAMAN, R., SUN, X., CHIU, W. T., COLPE, L. J., FULLERTON, C. S., GILMAN, S. E., HWANG, I., NAIFEH, J. A., NOCK, M. K., ROSELLINI, A. J.,

SAMPSON, N. A., SCHOENBAUM, M., ZASLAVSKY, A. M. & KESSLER, R. C. 2015. Prevalence and correlates of suicidal behavior among new soldiers in the U.S. Army: results from the Army Study to Assess Risk and Resilience in Servicemembers (Army STARRS). *Depress Anxiety,* 32**,** 3-12.

WALLER, M., MCGUIRE, A. C. & DOBSON, A. J. 2015. Alcohol use in the military: associations with health and wellbeing. *Subst Abuse Treat Prev Policy,* 10**,** 27.

WHITEFORD, H. A., DEGENHARDT, L., REHM, J., BAXTER, A. J., FERRARI, A. J., ERSKINE, H. E., CHARLSON, F. J., NORMAN, R. E., FLAXMAN, A. D., JOHNS, N., BURSTEIN, R., MURRAY, C. J. & VOS, T. 2013. Global burden of disease attributable to mental and substance use disorders: findings from the Global Burden of Disease Study 2010. *Lancet,* 382**,** 1575-86.

Figure Captions

Figure 1. Prevalence of lifetime binge drinking, heavy drinking, and drug use was estimated in the sample of survey respondents who consented to linkage of their responses to their Army/DoD administrative records, and who were administered a version of the survey instrument that contained the item assessing peak lifetime frequency of binge drinking ("Overall Sample"). Due to a limitation of the survey design, prevalence of probable Alcohol Use Disorder could only be estimated in a subsample of those soldiers who endorsed no or minimal lifetime use of non-alcohol drugs ("Restricted Sample").

Figure 2. Weighted prevalence of lifetime posttraumatic stress disorder, suicidal behavior, major depressive disorder, and panic disorder by categories of alcohol misuse. Standard errors range from 0.1% to 1.5%. Estimates were derived from the restricted sample of 26,754 new soldiers with no or minimal lifetime use of non-alcohol drugs. All four co-occurring conditions were more prevalent among soldiers with lifetime binge drinking, lifetime heavy drinking, lifetime probable AUD and past-year probable AUD than among soldiers with no lifetime alcohol misuse (all *p*'s<.001).

Table 1

Weighted prevalence of lifetime binge drinking, heavy drinking, and non-alcohol substance use in new Army soldiers

	Overall (*N*=30,583)	Males (*n*=25,736)	Females (*n*=4847)
Binge Drinking	25.8% (0.4%)	27.2% (0.4%)	18.9% (0.7%)
Heavy Drinking	13.1% (0.2%)	13.9% (0.3%)	9.4% (0.4%)
Marijuana/hashish	8.5% (0.2%)	8.7% (0.2%)	7.6% (0.5%)
Synthetic marijuana/spice	3.6% (0.1%)	3.8% (0.2%)	2.6% (0.3%)
Any other illegal drug	2.2% (0.1%)	2.3% (0.1%)	2.1% (0.2%)
Prescription analgesics	3.6% (0.1%)	3.6% (0.1%)	3.4% (0.2%)
Prescription stimulants	3.0% (0.1%)	3.0% (0.1%)	3.0% (0.2%)
Prescription tranquilizers	2.1% (0.1%)	2.1% (0.1%)	2.3% (0.2%)

Notes. Values are weighted percentage (standard error). Binge drinking was defined as consuming 5 or more drinks per day "1-3x/month" or more. Heavy drinking was defined as consuming 5 or more drinks per day 1-2x/week" or more. Non-alcohol drug use was considered present if peak lifetime frequency was "1-3x/month" or more. For prescription drugs, survey items specified that respondents should only consider use that occurred without a doctor's prescription; in excess of the amount prescribed; or to get "high, buzzed, or numbed out".

Table 2

Weighted prevalence of lifetime binge drinking, heavy drinking, and probable alcohol use disorder among new soldiers with infrequent (<monthly)[1] lifetime use of other substances

	Overall (*n*=26,754)	Males (*n*=22,452)	Females (*n*=4302)
Binge Drinking	20.7% (0.3%)	22.0% (0.4%)	14.3% (0.7%)

Heavy Drinking	9.3% (0.2%)	9.9% (0.2%)	6.4% (0.5%)
Probable lifetime AUD	9.1% (0.2%)	9.5% (0.2%)	7.2% (0.5%)
Probable past-year AUD	5.7% (0.2%)	5.9% (0.2%)	4.7% (0.5%)

Notes. AUD = Alcohol Use Disorder. Values are weighted percentage (standard error). Binge drinking was defined as consuming 5 or more drinks per day "1-3x/month" or more. Heavy drinking was defined as consuming 5 or more drinks per day "1-2x/week" or more.

[1]A sensitivity analysis was conducted using a less stringent exclusion criterion for non-alcohol drug use. Respondents whose peak lifetime use of non-alcohol drugs was "1-3x/month" were included in the sensitivity analysis sample, in addition to those whose peak frequency was "Never" and "Less than 1x/month" (*n* = 27,620). Prevalence estimates for Binge Drinking, Heavy Drinking, probable lifetime AUD, and probable past-year AUD were 21.7% (SE=0.3%), 9.9% (SE=0.2%), 10.0% (SE=0.2%), 6.3% (SE=0.2%), respectively (i.e., within 1% of the values reported in this table).

Table 3

Associations of temporally prior mental disorders with subsequent onset of alcohol use disorder among new soldiers with infrequent (<monthly) lifetime use of other substances (*n*=26,754)

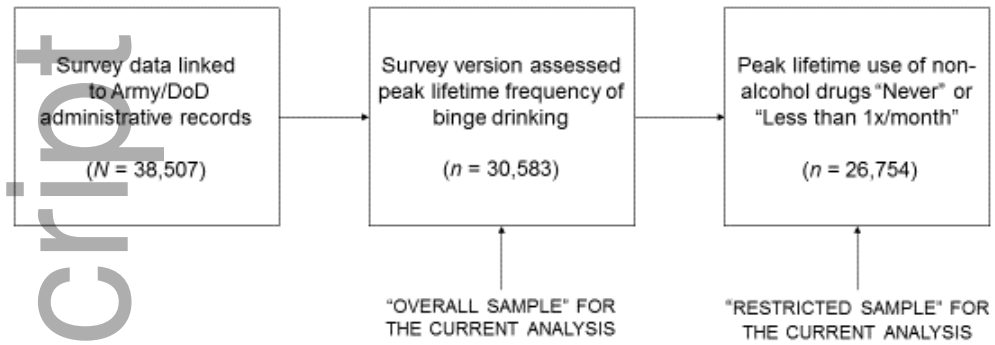|	Adjusted Odds Ratio	95% Confidence Interval	*p* value
Posttraumatic Stress Disorder	2.31	1.91-2.79	<.001
Major Depressive Disorder	2.70	2.28-3.21	<.001
Generalized Anxiety Disorder	2.73	2.32-3.21	<.001
Panic Disorder	2.66	1.97-3.60	<.001
Mania/hypomania	2.85	2.39-3.39	<.001
Suicidal Ideation	2.58	2.29-2.90	<.001

Note. Results are from six separate discrete-time survival models of onset of alcohol use disorder, with the row label indicating the predictor of interest. Odds ratios reflect adjustment for socio-demographic and Army service variables.

Table 4

Associations of temporally prior alcohol use disorder with subsequent onset of other mental disorders among new soldiers with infrequent (<monthly) peak lifetime use of other substances (*n*=26,754)

	Adjusted Odds Ratio	95% Confidence Interval	*p* value
Posttraumatic Stress Disorder	3.15	2.67-3.72	<.001
Major Depressive Disorder	2.92	1.56-5.46	<.001
Generalized Anxiety Disorder	2.24	1.76-2.84	<.001
Panic Disorder	2.12	1.27-3.53	0.004
Mania/hypomania	2.68	1.88-3.81	<.001
Suicidal Ideation	1.98	1.51-2.59	<.001

Note. Results are from separate discrete-time survival models of onset of the six different mental disorders, with alcohol use disorder as the predictor and the row label indicating the outcome in question. Odds ratios reflect adjustment for socio-demographic and Army service variables.

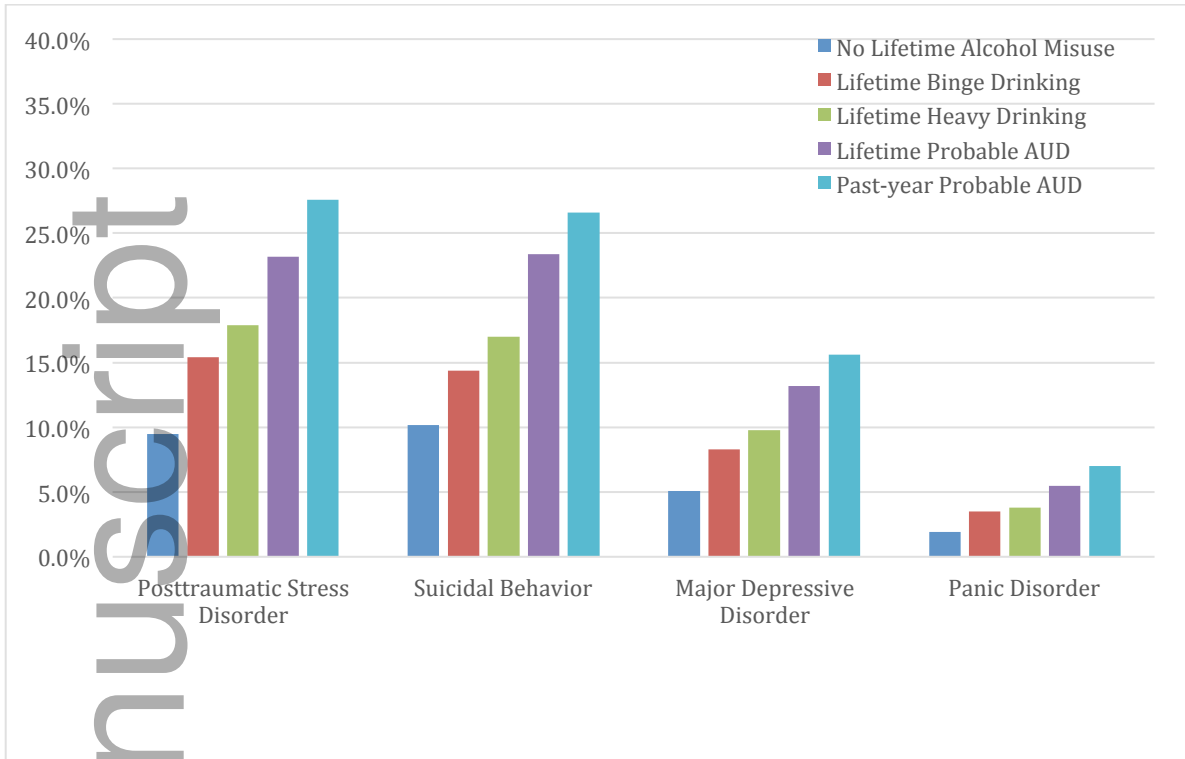| Survey data linked to Army/DoD administrative records (N = 38,507)	→	Survey version assessed peak lifetime frequency of binge drinking (n = 30,583)	→	Peak lifetime use of non-alcohol drugs "Never" or "Less than 1x/month" (n = 26,754)

"OVERALL SAMPLE" FOR THE CURRENT ANALYSIS

"RESTRICTED SAMPLE" FOR THE CURRENT ANALYSIS

Figure_2