Substance Use and Mental Health Risk Factors for Servicemembers: Findings from U.S. Department of Defense Health Related Behavior Surveys

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ABSTRACT

This paper examines trends in use and risk factors for six substance use and mental health indicators among United States active duty military personnel: cigarette smoking, heavy drinking, illicit drug use, depression, posttraumatic stress disorder (PTSD), and suicidal ideation. Data were drawn from the 2008 and earlier population-based Department of Defense Surveys of Health Related Behaviors. A focus was on service-level findings and how Navy and Air Force personnel compare with Army and Marine Corps personnel on these trends and risk factors. Trends showed notable and highly similar declines in use for all services for cigarette smoking and illicit drug use, but a much flatter pattern for heavy drinking accompanied by significant increases in use from 1998 to 2008. Rates of PTSD increased from 2005 to 2008 for all services, but rates of depression and suicidal ideation did not show any significant changes. Risk factors varied across substance abuse outcomes, but cigarette smoking and heavy drinking had the most in common. The main risk factor for mental health outcomes was a comorbid mental health condition (e.g., PTSD and suicidal ideation were strong predictors of depression). High combat exposure was predictive of cigarette use, heavy drinking, and PTSD. As hypothesized, risk for smoking, depression, and PTSD were elevated for Navy personnel similar to those for Army and Marine Corps personnel.

This paper is based on a presentation given at the NATO conference on Mental Health and Well-Being Across the Military Spectrum in Bergen, Norway, April 13, 2011. The 2008 DoD Health Related Behavior Survey was supported by contract GS-10F-0097L, Task Order W81XWH-07-F-0538 for the Assistant Secretary of Defense (Health Affairs) and Task Order HSCG23-07-F-PMD047 for the U.S. Coast Guard. Preparation of this paper was supported by internal funds from RTI International. The views, opinions, and findings contained in this report are those of the authors and should not be construed as an official Department of Defense position, policy, or decision, unless so designated by other official documentation.

INTRODUCTION

Dozens of scientific articles and task force reports have documented substantial mental health and substance abuse problems among returning Operation Iraqi Freedom (OIF)/Operation Enduring Freedom (OEF) military personnel since early in the conflicts [1–10]. These studies have noted mental health problems ranging from posttraumatic stress disorder (PTSD), anxiety disorders, depression, and suicide to alcohol and substance use disorders. Understandably, the focus has been on determining the scope of these problems in the returning warriors, almost exclusively among Soldiers and Marines.

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On the other hand, the conflicts may have less direct effects on the stress levels of the military as a whole and its overall mental health. Indeed, only recently have data become available suggesting that deployment stress rather than combat exposure per se is more strongly associated with PTSD among Marines back from war [11]. This raises the question of whether Services such as the Navy and Air Force that may deploy, but not be exposed to direct combat to the same degree as soldiers and Marines, are also at risk for increased mental health problems. Further, survey data suggest that military personnel who have not deployed are also at risk for mental health problems [12–14] raising issues of whether improved predeployment screening is influencing these rates or whether rates are higher among more recent recruits. To examine such issues, a population-based comparative epidemiologic study of all active duty military is needed.

This paper draws on data from the U.S. Department of Defense (DoD) Surveys of Health-Related Behaviors (HRB) Among Active Duty Military Personnel to examine prevalence, trends, and correlates associated with substance use and mental health issues. The DoD HRB surveys are large, comprehensive, population-based studies spanning a 28-year period from 1980 to 2008. We first report trends for key substance use and mental health indicators, including cigarette use, heavy alcohol use, illicit drug use, major depression, PTSD, and suicidal ideation across all four branches of service (Army, Navy, Marine Corps, Air Force). We then identify key sociodemographic and military risk factors associated with these problems in the military population, including deployment and combat exposure. We hypothesize that because the Navy personnel also deploys for many months, they will have increased rates of substance abuse and mental health problems, though not to the extent experienced by soldiers and Marines who are exposed to combat.

METHODS

Sampling and Data Collection

The eligible population for each of the surveys consisted of all active-duty military personnel except recruits, service academy students, persons absent without official leave, and persons who had a permanent change of station at the time of data collection. A two-stage probability design was used to first select a random sample of approximately 60 military installations (30 in 2002 because of changes in command activities after the September 11, 2001, attacks) located worldwide, stratified by Service and region of the world. In the second stage, personnel were stratified by pay grade and gender, and for the 1980 to 2005 surveys they were randomly selected without replacement from the participating installations. The 2008 survey followed the same selection procedures but used replacement sampling. An alternate sample that matched servicemembers by pay grade and gender was used to replace personnel who were inaccessible owing to deployments, temporary duty assignments, leave, transfers, or discharge. Military pay grade for enlisted personnel was grouped from junior to senior rank as E1 to E3, E4 to E6, and E7 to E9. Pay grades for commissioned officers and warrant officers were grouped as O1 to O3, O4 to O10, and W1 to W5. Officers and women were oversampled because of their smaller numbers.

Post-stratification methods were used to develop nonresponse adjustment factors. Updated counts of military personnel were obtained from Defense Manpower Data Center, and observed eligibility rates were applied to these new personnel counts for the sampling strata defined by the intersection of Service, region, gender, and pay grade groups. Adjustment factors were then calculated and applied to the weights to correct for differences in the proportion responding in the sample relative to the proportion in the population.

We followed a two-phase data collection procedure. Phase 1 consisted of on-site administration of anonymous self-report questionnaires by civilian data collection teams. Questionnaires took approximately 55 minutes on average to answer. Phase 2 consisted of mailing questionnaires to persons not attending on-site

administrations (2008 survey omitted this mailing because of replacement sampling) and to personnel in remote duty locations. All questionnaires were accompanied by information explaining the purpose and anonymity of the survey. Most of the data (97% in 2008) were obtained from the group sessions. Additional details on sampling procedures and design are summarized in the 2008 final report [12].

The sample sizes for the surveys were 15,268 in 1980; 21,936 in 1982; 17,328 in 1985; 18,673 in 1988; 16,395 in 1992; 16,193 in 1995; 17,264 in 1998; 12,756 in 2002; 16,146 in 2005; and 28,546 in 2008. Response rates ranged from 84% to 52% across survey years with a response rate of 71% for 2008.

Key Measures

The questionnaire included background and military characteristics, information on substance use, and measures of mental health issues. For our analyses, background characteristics included gender, race/ethnicity, education, age group, and family status. Military characteristics included pay grade (rank), branch of service, and combat exposure. Combat exposure was assessed using 17 items characterizing the frequency with which respondents experienced combat-related circumstances such as being sent outside the wire, receiving incoming fire or encountering other munitions, firing on the enemy, witnessing serious injuries or casualties, and other events. Each item asked how many times respondents were exposed, with response options 0 = "0 times," 1 = "1 to 3 times," 2 = "4 to 12 times," 3 = "3 to 50 times," and 4 = "51 or more times." All items were summed, and the sum score was used to create a categorical combat exposure item where a score equal to zero was considered "no combat exposure," a score from 1 to 9 was classified as "Moderate Combat Exposure," and a score of 10 or greater was considered as "High Combat Exposure." A fourth category was added to capture personnel who had not been deployed. These cut-off scores were examined with factor analysis and item scoring methods that suggest these categories captured meaningful distinctions among groups of scores.

Six outcome measures were examined: past month cigarette use, past month heavy alcohol use, past month illicit drug use, depression, PTSD, and past year suicide contemplation. These were defined as follows:

- **Cigarette Use.** Cigarette use was defined as smoking one or more times in the past month and at least 100 cigarettes during the lifetime.
- **Heavy Alcohol Use.** Heavy alcohol use was defined as drinking five or more drinks per typical drinking occasion at least once a week in the 30 days before the survey.
- **Illicit Drug Use.** The survey asked about past month use of illicit (nonprescription) drugs and nonmedical use of prescription drugs separately. Illicit drugs included marijuana or hashish; cocaine; LSD, PCP, MDMA, and other hallucinogens; methamphetamine; heroin; GHB/GBL, and inhalants. Prescription drugs included stimulants other than methamphetamine, tranquilizers or muscle relaxers, sedatives or barbiturates, pain relievers, and anabolic steroids. "Nonmedical use" was defined as any use of these drugs without a doctor's prescription, in greater amounts or more often than prescribed, or for reasons such as to get "high," or for "thrills" or "kicks." An index of any drug use was constructed by creating use/no use dichotomies for each drug category and assigning a 1 to the index if any drug was used.
- **Depression.** Need for further depression evaluation was assessed using the three-item Version-A Burnam depression screen. Personnel were defined as needing further evaluation or assessment if they (a) felt sad, blue, or depressed for 2 weeks or more in the past 12 months *or* (b) reported 2 or more years in their lifetime of feeling depressed and felt depressed "much of the time" in the past 12 months; *and* (c) felt depressed on 1 or more days in the past week [15].

- **Posttraumatic Stress Disorder.** Need for further PTSD evaluation was assessed using the 17-item PTSD Checklist-Civilian Version ([PCL-C] [16]). Personnel scoring 50 or more were classified as needing further evaluation for PTSD. The civilian version of the PCL was selected to assess PTSD symptoms that may be the result of either military or nonmilitary experiences (i.e., traumatic exposures that occurred before joining the military or that occurred outside of military duty).
- **Suicidal Ideation.** Suicidal ideation was assessed by asking respondents whether they had seriously considered suicide within the past year. Individuals responded based on their own definitions of what it meant to them to have seriously considered suicide.

Analytic Approach

Logistic regression models were used to estimate the relationship of the demographic and service-related predictors to the mental health and substance use outcomes of interest. Each mental health and substance use measure was also entered as a predictor for models in which that particular measure was not the dependent variable. Predictor significance was assessed with odds ratios and their confidence intervals. The logistic regression models were also used to estimate conditional marginal estimates of each outcome by predictor category, or the estimated prevalence of each outcome adjusted for the set of independent variables in the model. Data analyses for this study were performed using SUDAAN [17] to account for the complex survey design of the HRB data. Data were weighted to represent the active-duty population and to account for nonresponse adjustment (as discussed above). Only DoD services (Army, Navy, Air Force, Marines) were included in the analysis.

RESULTS

Trends in Substance Abuse

Figure 1 presents the trends from 1980 to 2008 of the percentage of the active-duty personnel in the Army, Navy, Marine Corps, and Air Force who smoked cigarettes during the past 30 days. As shown, the four services had a statistically significant downward trend in past-month use of cigarettes over the years. In the early years the Army and Navy rates of use were highest, followed by the Marine Corps and Air Force. Beginning in 1992, rates of use for the Marines began to overtake those of the Army and Navy and have generally been the highest among the services since 1998. It is notable that Marine Corps' smoking rates stayed level or increased slightly from 2005 to 2008, whereas those of the other three services trended downward. Air Force smoking rates have been the lowest of all services over the 28-year period of the surveys.

Figure 2 presents the trends in past month heavy drinking for each of the services over the 28-year period that the 10 surveys were conducted. As shown, heavy alcohol use has experienced some fluctuations over the years, but the rate in 2008 was very similar to that in 1980 for the Army, Marines, and Air Force. Only the Navy has sustained a significantly lower level at the end of the period. The heavy drinking rates of the Marines have consistently been the highest of the services over the years, and the rates for the Air Force have been the lowest. The Navy has matched the Air Force rates for two of the surveys but then showed subsequent increases. All services showed significant increases from 1998 to 2008.

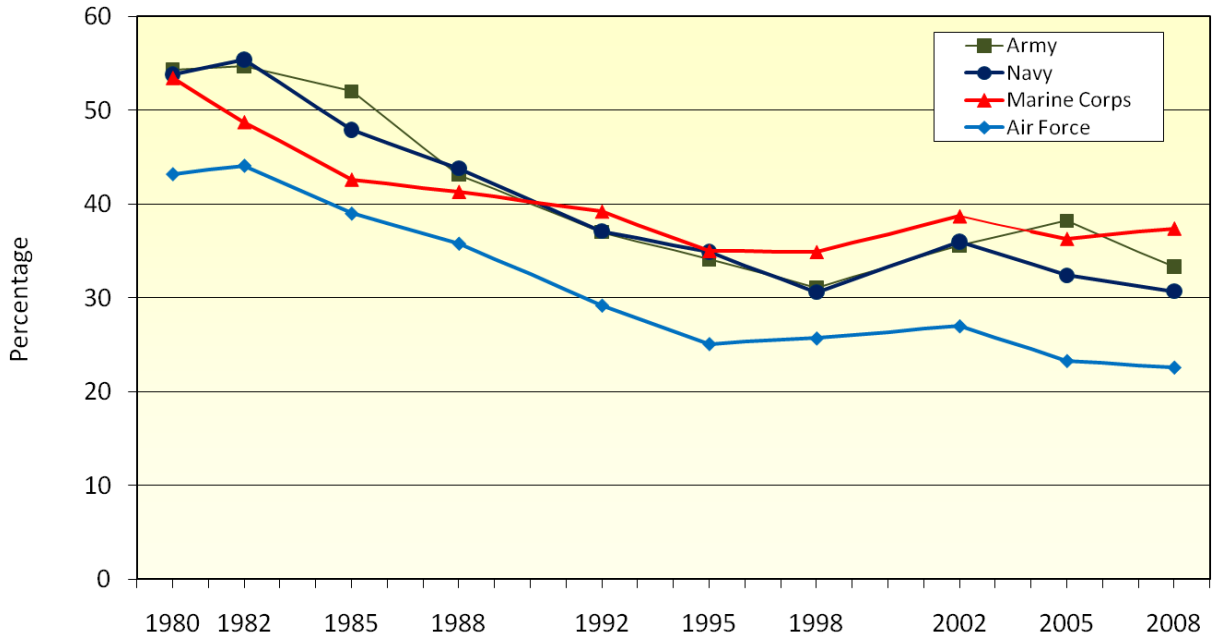

Figure 1: Trends in Cigarette Use, Past 30 Days, by Service, 1980-2008.

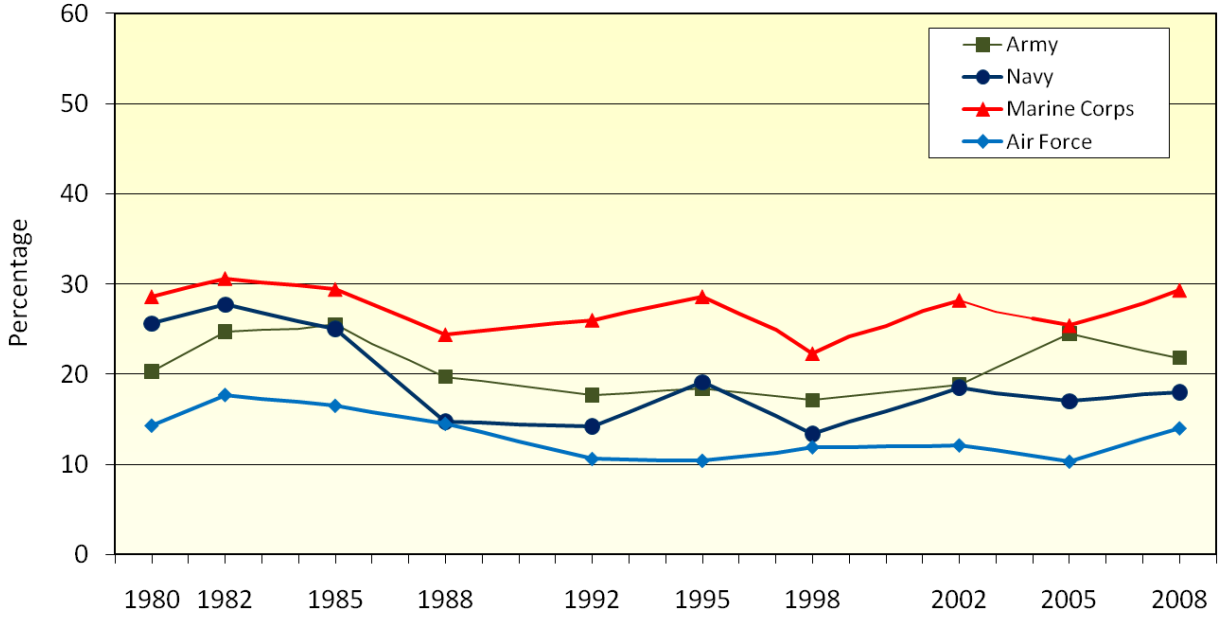

Figure 2: Trends in Heavy Alcohol Use, Past 30 Days, by Service, 1980-2008.

Figure 3 presents the trends in any illicit drug use across the survey years. As shown in the top portion of the figure, there has been a statistically significant downward trend in past-month use of illicit drugs over the

years by all four of the services. The pattern is strikingly similar across branches: with steep declines from 1980 to 1988 and then a leveling off at a very low rate through 2002. In 2005 and 2008 there are some increases that are mostly associated with misuse of prescription drugs. Improved question wording in 2005 and 2008 may partially account for the higher observed rates, which are largely attributable to reported increases in misuse of prescription pain medications. The bottom portion of the graph presents the rates of illicit drug use when prescription drugs are omitted. As shown, when prescription drugs were omitted, illicit drug use continued at the low rates observed in 2002.

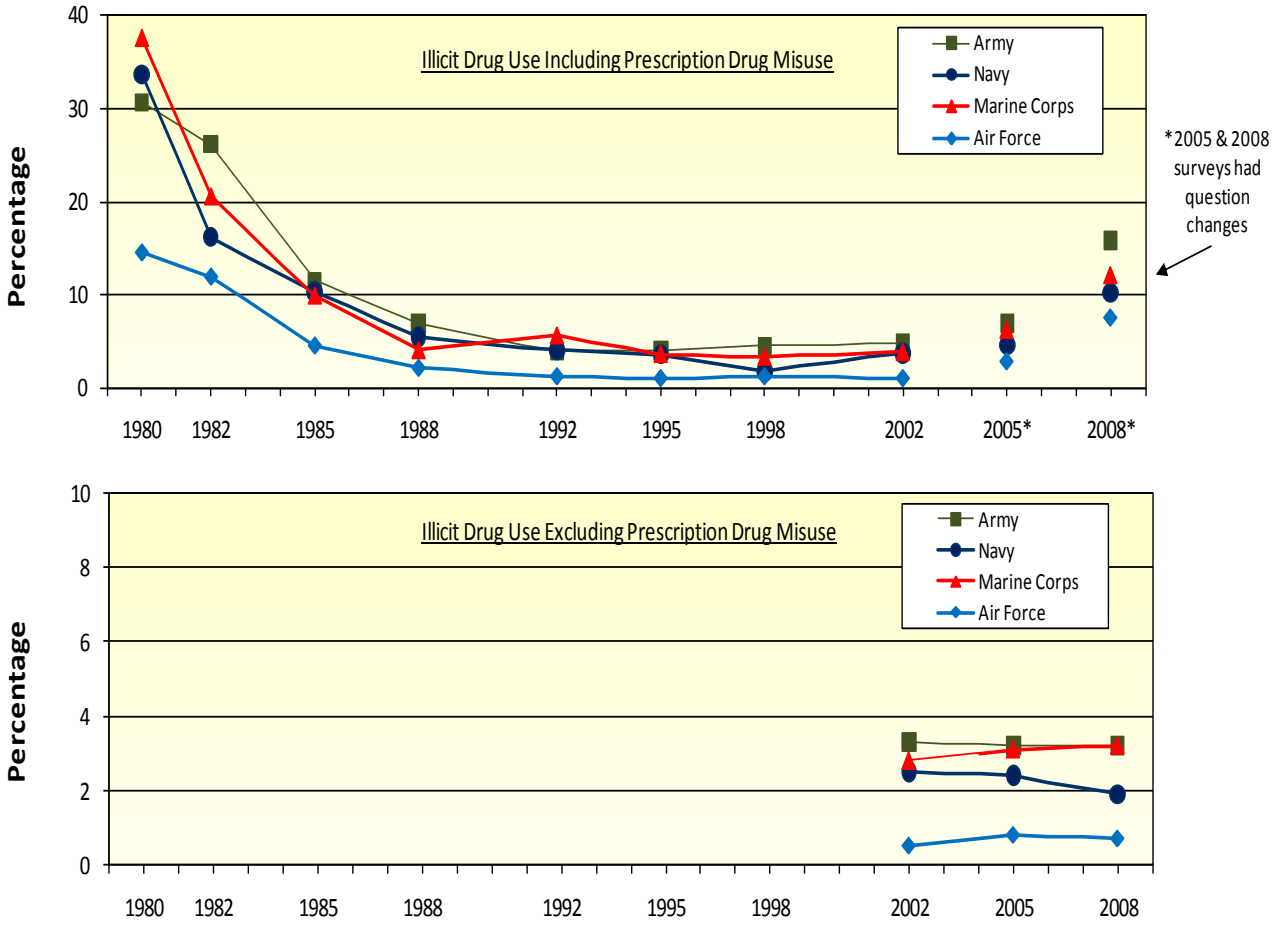

Figure 3: Trends in Illicit Drug Use, Past 30 Days, by Service, 1980-2008.

Figure 4 provides further insight into the role of prescription drug misuse in rates of drug abuse. These rates are overall for the four services combined. As shown, the use of individual drugs other than pain relievers was 3% or less. Pain relievers were the most commonly used drug in 2005 and 2008, with past month rates of 3% in 2005 and 10% in 2008.

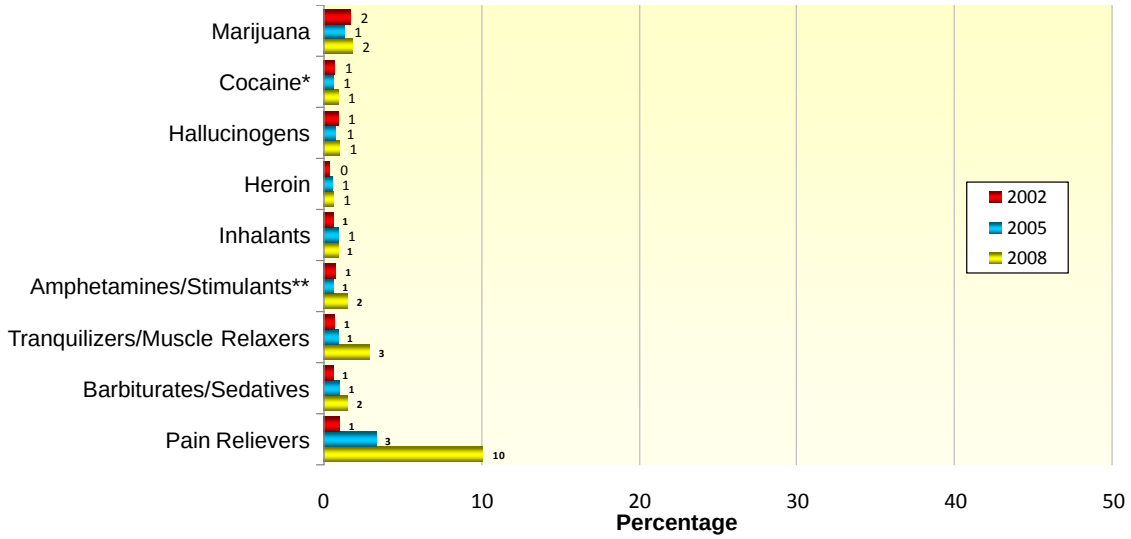

Figure 4: Use of Selected Illicit Drugs, Past 30 Days, DoD Services, 2002, 2005, and 2008.

Trends in Mental Health Issues

The present study examined three mental health outcomes: depression, PTSD symptoms, and suicide contemplation. Trends from 2005 to 2008 were examined for each of these measures.

Figure 5 shows trends in the need for further depression evaluation as measured by the depression symptom screener. Slightly more than 20% of personnel in both 2005 and 2008 met screening criteria. As expected, Army and Marine Corps personnel showed the highest rates, with approximately one-quarter of their populations needing further depression evaluation. Of interest was a slight but significant reduction in rates from 2005 to 2008 among Army and Air Force personnel. Navy and Marine Corps personnel showed a slight but nonsignificant increase in the same time period.

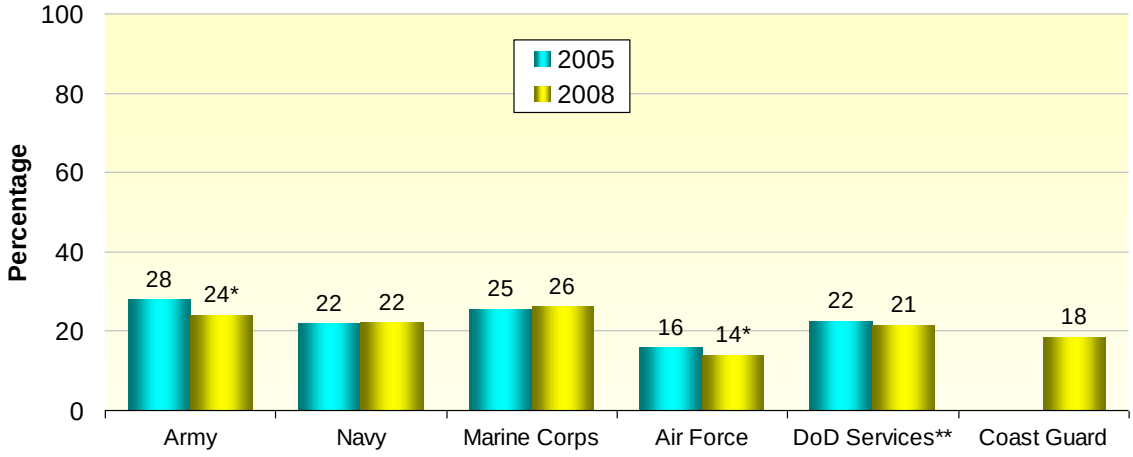

Figure 5: Need for Further Depression Evaluation in Past 7 Days by Service, 2005 and 2008.

Figure 6 shows trends in the need for further PTSD evaluation as measured by the PCL-C screener, with a cutoff of 50. As shown, an estimated 11% of DoD personnel met screening criteria in 2008, a significant increase from the 7% reported in 2005. All branches of service showed a significant increase from 2005, with the largest increase among Marines: 15% of that service showed rates suggesting the need for further PTSD evaluation.

Figure 7 shows trends in suicidal ideation almost reaching 5% for the DoD as a whole in 2005 and 2008. The Marine Corps had the highest rate in both years, and the Air Force had the lowest rates. There were no significant changes from 2005 to 2008 in the rate of seriously considering suicide in the past year in any of the services.

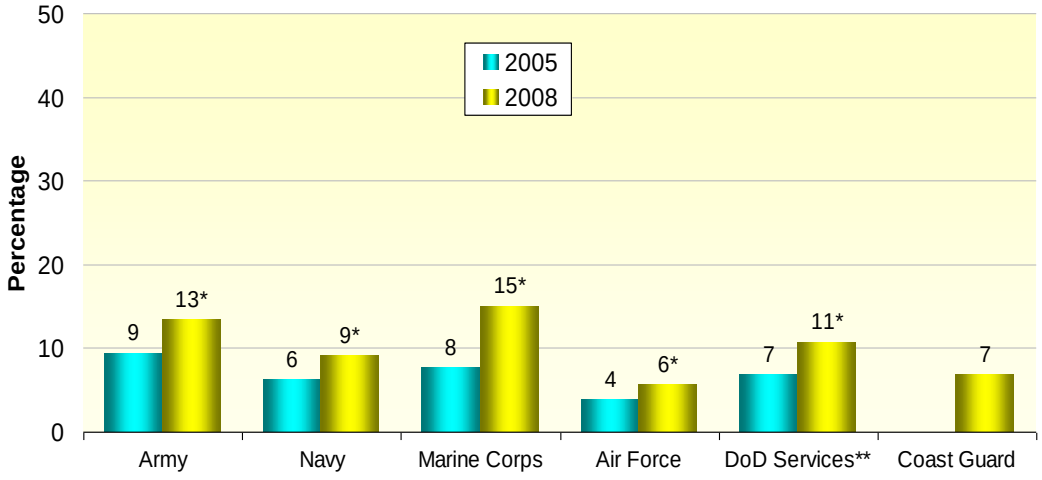

Figure 6: Need for Further PTSD Evaluation in Past 30 Days by Service, 2005 and 2008.

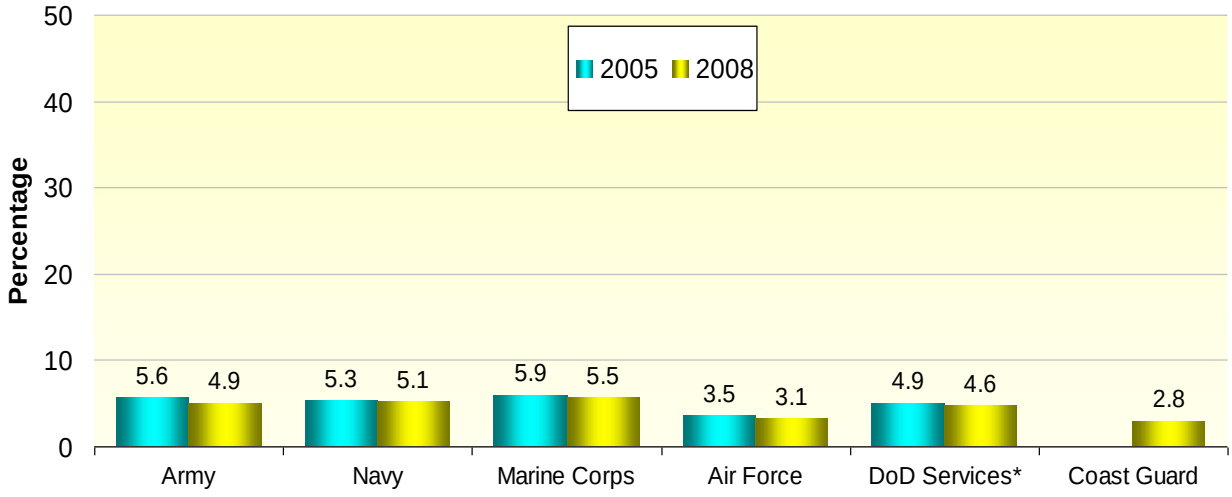

Figure 7: Seriously Considered Suicide in Past Year by Service, 2005 and 2008.

Likelihood of Substance Use

Table 1 presents the results from the logistic regressions for the substance use outcome measures of cigarette smoking, heavy drinking, and illicit drug use. The overall prevalence of cigarette use among active duty U.S. military personnel was 30.6%, with the highest adjusted rates among those who were heavy drinkers (43%), junior enlisted personnel in pay grades of E1-E3 (35%), and those with a high school education or less (32%). The significant risk factors for cigarette smoking were being male; being white non-Hispanic; having less than a college education; being aged 26 to 34; being of any rank except warrant office and senior officer, but especially being enlisted personnel rather than an officer; being in the Army, Navy, or Marines; being deployed regardless of level of combat exposure; engaging in illicit drug use; screening positive for depression and screening positive for PTSD. The strongest predictors were being of enlisted rank (ORs = 3.0 to 5.8), being a heavy drinker (OR = 2.7), and having a high school or less education (OR = 2.3).

The overall prevalence of heavy alcohol use was 20%, with highest adjusted rates among cigarette smokers (26%), personnel aged 21 to 25 (22%), those who use illicit drugs (21%), who screen positive for PTSD (21%), and those who hold the rank of warrant officer (20%). The significant risk factors for heavy drinking were being male, being white non-Hispanic or Hispanic, having a high school education or less, being aged 21 to 34, not partnered, or partnered with partner not present, being of senior enlisted (E7 to E9) or Warrant officer rank, being in the Marines, having high combat exposure, being a heavy drinker, engaging in illicit drug use, and meeting screening criteria for PTSD. The strongest predictors were being male (OR = 2.8), being a cigarettes smoker (OR = 2.7), and being aged 21 to 25 (OR = 2.4).

The overall prevalence of illicit drug use in the past month was 12% with highest adjusted rates among persons who screened positive for PTSD (16%), heavy drinkers (13%), personnel in the Army (12%), and cigarette smokers (11%). The significant risk factors for illicit drug use after adjusting for other factors in the model were being female, being of any race/ethnicity except white non-Hispanic, being in the Army, being a cigarette smoker, being a heavy drinker, and meeting criteria for depression and PTSD. The strongest predictors were screening positive for PTSD (OR = 2.0), serving in the Army (OR = 1.7), and being a heavy drinker (OR = 1.6).

Table 1: Correlates of Cigarette Smoking, Heavy Drinking, and Illicit Drug Use in the Past Month.

Independent Variables	Cigarette Smoking			Heavy Drinking			Illicit Drug Use		
	Adj %	Adj ORs (95% CI)		Adj %	Adj ORs (95% CI)		Adj %	Adj ORs (95% CI)	
Gender									
Male	26.30	1.33*	(1.16-1.53)	17.05	2.75*	(2.26-3.34)	8.96	0.77*	(0.70-0.85)
Female	21.16	1.00		6.96	1.00		11.34	1.00	
Race/Ethnicity									
White–non-Hispanic	29.85	1.24*	(1.06-1.45)	16.04	1.35*	(1.10-1.64)	8.32	0.75*	(0.60-0.92)
African American–non-Hispanic	15.00	0.51*	(0.44-0.60)	11.87	0.95	(0.78-1.16)	12.37	1.16	(0.88-1.53)
Hispanic	18.55	0.66*	(0.54-0.81)	16.78	1.42*	(1.13-1.78)	10.53	0.97	(0.73-1.28)
Other	25.54	1.00		12.43	1.00		10.86	1.00	
Education									
High school or less	32.42	2.33*	(1.87-2.91)	17.21	1.46*	(1.12-1.90)	10.26	1.19	(0.88-1.60)
Some college	26.25	1.73*	(1.44-2.07)	15.16	1.26	(0.98-1.61)	8.92	1.02	(0.80-1.30)
College degree or more	17.08	1.00		12.46	1.00		8.78	1.00	
Age									
20 or younger	22.47	0.93	(0.69-1.24)	10.89	1.06	(0.74-1.51)	7.98	0.75	(0.53-1.06)
21-25	26.17	1.13	(0.93-1.39)	21.80	2.41*	(1.96-2.98)	8.97	0.85	(0.69-1.05)
26-34	27.82	1.23*	(1.05-1.45)	16.06	1.66*	(1.42-1.93)	9.34	0.89	(0.73-1.09)
35 or older	23.81	1.00		10.35	1.00		10.38	1.00	
Family Status									
Not married/not living with a partner	25.89	1.05	(0.98-1.14)	19.47	1.76*	(1.56-1.99)	9.40	1.04	(0.88-1.23)
Married/living with partner - partner not present	27.28	1.13	(0.98-1.31)	17.31	1.53*	(1.30-1.80)	10.02	1.12	(0.89-1.41)
Married/living with partner - partner present	24.92	1.00		12.05	1.00		9.07	1.00	
Pay Grade									
E1-E3	35.04	5.81*	(3.67-9.21)	16.63	1.56	(0.97-2.50)	11.96	1.67	(0.98-2.85)
E4-E6	29.99	4.62*	(3.10-6.87)	14.83	1.36	(0.88-2.11)	9.81	1.34	(0.86-2.08)
E7-E9	21.81	3.01*	(1.98-4.55)	17.13	1.61*	(1.03-2.54)	9.28	1.26	(0.87-1.83)
W1-W5	12.07	1.48	(0.90-2.44)	20.13	1.97*	(1.26-3.07)	5.78	0.75	(0.29-1.99)
O1-O3	14.25	1.79*	(1.16-2.75)	13.50	1.22	(0.76-1.97)	5.23	0.68	(0.39-1.18)
O4-O10	8.49	1.00		11.35	1.00		7.51	1.00	
Service									
Army	28.25	1.50*	(1.22-1.84)	15.17	1.10	(0.87-1.40)	11.78	1.65*	(1.36-2.00)
Navy	26.52	1.37*	(1.17-1.61)	14.20	1.02	(0.88-1.19)	8.30	1.12	(0.92-1.35)
Marine Corps	25.74	1.32*	(1.09-1.59)	18.82	1.43*	(1.21-1.69)	8.53	1.15	(1.00-1.33)
Air Force	20.82	1.00		13.94	1.00		7.49	1.00	

Independent Variables	Cigarette Smoking			Heavy Drinking			Illicit Drug Use		
	Adj %	Adj ORs (95% CI)		Adj %	Adj ORs (95% CI)		Adj %	Adj ORs (95% CI)	
Combat Exposure									
Not deployed	21.61	1.00		12.82	1.00		8.85	1.00	
Deployed-none	26.15	1.28*	(1.12-1.47)	15.33	1.23	(0.98-1.54)	8.17	0.92	(0.76-1.10)
Deployed-low/moderate	28.36	1.44*	(1.26-1.63)	14.37	1.14	(0.98-1.33)	9.83	1.12	(0.89-1.41)
Deployed-moderate/high	27.50	1.38*	(1.20-1.58)	18.95	1.59*	(1.31-1.92)	10.55	1.22	(0.97-1.52)
Cigarette Smoking in Past Month									
Yes	-		-	26.28	2.70*	(2.41-3.02)	10.71	1.25*	(1.07-1.47)
No	-		-	11.67	1.00		8.73	1.00	
Heavy Drinking in Past Month									
Yes	43.23	2.69*	(2.40-3.01)	-		-	13.13	1.62*	(1.38-1.90)
No	22.08	1.00		-		-	8.53	1.00	
Illicit Drug Use in Past Month									
Yes	29.45	1.25*	(1.06-1.47)	21.34	1.61*	(1.37-1.90)	-		-
No	25.05	1.00		14.41	1.00		-		-
Need for Further Depression Evaluation									
Yes	30.20	1.34*	(1.19-1.52)	15.73	1.07	(0.93-1.22)	11.09	1.28*	(1.07-1.54)
No	24.37	1.00		14.89	1.00		8.86	1.00	
Screened Positive for PTSD									
Yes	28.83	1.21*	(1.05-1.39)	21.26	1.60*	(1.28-2.00)	16.15	2.02*	(1.71-2.39)
No	25.15	1.00		14.47	1.00		8.70	1.00	
Suicidal Ideation in Past 12 Months									
Yes	27.37	1.11	(0.91-1.34)	17.17	1.18	(0.95-1.46)	10.98	1.22	(0.93-1.59)
No	25.42	1.00		14.97	1.00		9.21	1.00	
Total	30.64			20.00			12.01		

Source: DoD Survey of Health Related Behaviors Among Active Duty Military Personnel, 2008

*****Estimate is significantly different from the reference group at the 95% confidence level.

Likelihood of Mental Health Issues

Table 2 presents the results from the logistic regressions for the mental health outcome measures of depression, PTSD, and suicidal ideation. The overall prevalence of depression among active duty U.S. military personnel was 21%, with the highest adjusted rates among those who screen positive for PTSD (69%); reported suicidal thoughts (50%); were female (23%); were partnered, but unaccompanied (23%) or unpartnered (20%); and were illicit drug users (20%) or smokers (20%). The significant risk factors for depression were being female; partnered, but unaccompanied or unpartnered; being in the Army, Navy, or Marines; being a cigarette smoker; using illicit drugs in the past month, meeting screening criteria for PTSD; and having serious suicidal thoughts. The strongest predictors were screening positive for PTSD (OR = 13.9) and having suicidal thoughts (OR=5.2).

The overall prevalence of PTSD among active duty U.S. military personnel was 11%, with the highest adjusted rates among those who screen positive for depression (26%), reported suicidal ideation (10%), experienced high combat exposure (10%), used illicit drugs (8%), reported heavy drinking (6%), and were in pay grades E1 to E3 (7%). The significant risk factors for PTSD were being female; being in an enlisted pay grade (especially E1 to E3) or junior officer; being in the Army, Navy, or Marines; having high combat exposure; being a cigarette smoker, heavy drinker, or illicit drug user; meeting screening criteria for depression; and having serious suicidal thoughts. The strongest predictors were screening positive for depression (OR = 14.0), being in pay grades E1 to E3 (OR = 5.1) and E4 to E6 (OR = 3.7), having high combat exposure (OR = 3.2), and having suicidal thoughts (OR = 2.8).

The overall prevalence of suicidal ideation among active duty U.S. military personnel was relatively low at 5%, with the highest adjusted rates among those who screened positive for depression (9%), who screened positive for PTSD (6%), and comprised the Other race/ethnicity category (4%). The significant risk factors and strongest predictors for suicidal ideation were meeting screening criteria for depression (OR=5.2) and PTSD (OR=2.7). Having moderate combat exposure relative to not being deployed was a protective factor.

DISCUSSION

The patterns of the substance use trends among the four DoD services highly resembled one another for cigarette use, heavy drinking, and illicit drug use. That is, for each substance the shape of the trend lines was similar across services even though that shape varied within substances. Cigarette smoking and illicit drug use trends showed substantial declines from 1980 to 2008, whereas the heavy drinking trend has been more flat, and all services showed increases from 1998 to 2008. For all three substances, Air Force personnel showed the lowest rates of use. Servicemembers in the Marine Corps were most likely to be heavy drinkers and somewhat more likely to smoke cigarettes in the later survey years than the other services.

All services showed higher rates of illicit drug use in 2008 than in prior years which is attributed primarily to prescription drug misuse. Unfortunately, wording changes in the way the drug questions were asked introduced method differences among the surveys and may account for some of the observed changes. Because of multiple potential explanations, the magnitude of the prescription drug misuse increases should be interpreted cautiously. Still, other recent military data appear to corroborate concerns about higher rates of prescription drug misuse [18]. As the military copes with providing care to wounded servicemembers, the possibility of increasing prescription drug misuse will need to be monitored closely and will need additional study.

Table 2: Correlates of Depression, PTSD, and Suicidal Ideation.

Independent Variables	Depression			PTSD			Suicidal Ideation		
	Adj %	Adj ORs (95% CI)		Adj %	Adj ORs (95% CI)		Adj %	Adj ORs (95% CI)	
Gender									
Male	16.33	0.65*	(0.57-0.73)	4.07	0.77*	(0.67-0.89)	2.57	1.03	(0.81-1.31)
Female	23.17	1.00		5.19	1.00		2.50	1.00	
Race/Ethnicity									
White–non-Hispanic	18.07	0.98	(0.82-1.17)	4.15	0.87	(0.67-1.13)	2.21	0.49*	(0.39-0.61)
African American–non-Hispanic	13.80	0.71*	(0.56-0.91)	4.39	0.92	(0.65-1.31)	3.02	0.67*	(0.50-0.89)
Hispanic	16.67	0.89	(0.72-1.10)	3.95	0.83	(0.59-1.15)	3.23	0.72*	(0.52-0.98)
Other	18.33	1.00		4.75	1.00		4.45	1.00	
Education									
High school or less	17.68	1.13	(0.94-1.37)	4.14	1.07	(0.80-1.44)	2.43	0.80	(0.58-1.11)
Some college	17.61	1.13	(0.97-1.32)	4.46	1.16	(0.86-1.55)	2.42	0.79	(0.62-1.02)
College degree or more	15.95	1.00		3.88	1.00		3.03	1.00	
Age									
20 or younger	16.06	0.84	(0.69-1.02)	5.13	1.31	(0.89-1.94)	3.06	1.27	(0.76-2.10)
21-25	17.07	0.90	(0.77-1.05)	4.20	1.06	(0.84-1.35)	2.64	1.09	(0.79-1.49)
26-34	16.79	0.88	(0.74-1.05)	4.06	1.03	(0.84-1.26)	2.38	0.97	(0.68-1.40)
35 or older	18.61	1.00		3.97	1.00		2.43	1.00	
Family Status									
Not married/not living with a partner	20.44	1.53*	(1.38-1.71)	3.90	0.86*	(0.74-0.99)	2.69	1.06	(0.87-1.29)
Married/living with partner - partner not present	22.68	1.75*	(1.49-2.05)	3.88	0.85	(0.73-1.00)	2.23	0.88	(0.63-1.22)
Married/living with partner - partner present	14.36	1.00		4.52	1.00		2.53	1.00	
Pay Grade									
E1-E3	18.84	1.27	(0.91-1.78)	6.55	5.09*	(2.27-11.41)	2.61	1.53	(0.76-3.06)
E4-E6	18.05	1.20	(0.94-1.54)	4.84	3.70*	(1.71-8.00)	2.75	1.62	(0.87-3.01)
E7-E9	14.33	0.91	(0.69-1.22)	3.11	2.33*	(1.12-4.86)	2.49	1.46	(0.84-2.51)
W1-W5	12.83	0.80	(0.60-1.08)	1.02	0.75	(0.09-6.15)	3.60	2.13	(0.86-5.26)
O1-O3	15.58	1.01	(0.77-1.32)	3.31	2.49*	(1.05-5.89)	2.21	1.29	(0.62-2.70)
O4-O10	15.47	1.00		1.36	1.00		1.72	1.00	
Service									
Army	18.20	1.49*	(1.31-1.69)	4.44	1.30*	(1.07-1.57)	2.39	0.97	(0.70-1.35)
Navy	19.53	1.63*	(1.40-1.89)	4.34	1.27*	(1.07-1.50)	3.09	1.26	(0.90-1.77)
Marine Corps	19.80	1.66*	(1.39-1.97)	5.06	1.49*	(1.23-1.81)	2.39	0.97	(0.71-1.34)
Air Force	12.98	1.00		3.45	1.00		2.46	1.00	

Independent Variables	Depression			PTSD			Suicidal Ideation		
	Adj %	Adj ORs (95% CI)		Adj %	Adj ORs (95% CI)		Adj %	Adj ORs (95% CI)	
Combat Exposure									
Not deployed	16.96	1.00		3.27	1.00		2.79	1.00	
Deployed-none	16.76	0.99	(0.83-1.17)	3.25	0.99	(0.76-1.29)	2.65	0.95	(0.72-1.25)
Deployed-low/moderate	17.76	1.06	(0.90-1.25)	3.19	0.97	(0.76-1.26)	2.11	0.75*	(0.59-0.95)
Deployed-moderate/high	17.51	1.04	(0.88-1.23)	9.78	3.20*	(2.49-4.12)	2.68	0.96	(0.71-1.30)
Cigarette Smoking in Past Month									
Yes	20.30	1.33*	(1.18-1.51)	4.80	1.21*	(1.04-1.42)	2.76	1.12	(0.92-1.36)
No	16.05	1.00		3.99	1.00		2.48	1.00	
Heavy Drinking in Past Month									
Yes	17.87	1.06	(0.92-1.21)	5.99	1.58*	(1.26-1.98)	2.88	1.16	(0.94-1.44)
No	17.07	1.00		3.88	1.00		2.49	1.00	
Illicit Drug Use in Past Month									
Yes	20.44	1.27*	(1.05-1.53)	7.64	2.03*	(1.70-2.42)	3.09	1.24	(0.95-1.63)
No	16.87	1.00		3.92	1.00		2.50	1.00	
Need for Further Depression Evaluation									
Yes	-		-	26.40	13.98*	(12.14-16.08)	8.92	5.23*	(4.20-6.53)
No	-		-	2.50	1.00		1.84	1.00	
Screened Positive for PTSD									
Yes	68.93	13.88*	(12.09-15.92)	-		-	5.99	2.68*	(2.34-3.07)
No	13.79	1.00		-		-	2.32	1.00	
Suicidal Ideation in Past 12 Months									
Yes	50.18	5.19*	(4.16-6.48)	10.47	2.77*	(2.40-3.21)	-		-
No	16.25	1.00		4.04	1.00		-		-
Total	21.17			10.70			4.62		

Source: DoD Survey of Health Related Behaviors Among Active Duty Military Personnel, 2008

*****Estimate is significantly different from the reference group at the 95% confidence level.

The similar pattern of trends by the services and the striking reductions in substance use rates for cigarettes and illicit drugs reflect the emphasis that all military branches have placed on prevention and control of substance abuse and suggest that these efforts have been relatively successful. The drug-testing program likely plays an important role in the low rates of drug use. In contrast, the relatively flat trend and more recent increases in heavy drinking suggests that existing alcohol-misuse prevention programs and campaigns have not had their desired outcome for this subset of users. This is of considerable concern because heavy drinkers are the group most likely to experience negative outcomes that impact their own health and degrade military readiness [12, 19].

There was no clear pattern of risk factors for cigarette smoking, heavy drinking, or illicit drug use although cigarettes and alcohol had the most in common, in part perhaps because of their comorbidity. For smoking, the strongest predictors were being in the enlisted ranks followed by being a heavy drinker. For heavy drinking, the strongest predictors were being male, being a cigarette smoker, and being of young adult ages 21 to 25. Several other variables also predicted cigarette use and heavy alcohol use, including service, high combat exposure, and meeting criteria for PTSD. Serving in the Army, Navy, or Marine Corps had a higher risk of smoking than serving in the Air Force, whereas serving in the Marines had a higher risk of heavy drinking. These findings for cigarette smoking were consistent with our hypothesis that the personnel in the Navy are also at elevated risk for substance abuse similar to those in the Army and Marine Corps. The strongest risk factor for illicit drug use was meeting criteria for PTSD, followed by serving in the Army. Smoking and heavy drinking were also risk factors for illicit drug use. Our finding showing that substance use and mental health problems are related is also consistent with civilian data [20].

Overall, the mental health findings showed slight decreases or no change in depression and suicidal ideation rates between 2005 and 2008, but significant increases in PTSD in each DoD service. For each of the mental health outcomes, the main risk factors were a comorbid mental health condition (i.e., PTSD predicted by depression and suicidal ideation, depression and suicidal ideation predicted by PTSD). This indicates the highly comorbid nature of these disorders in the military population. High combat exposure was a main predictor of PTSD but was not a significant predictor of depression or suicidal ideation, most likely due to the high comorbidity of the PTSD accounting for such a large proportion of the risk (69%). As hypothesized, the risk for depression and PTSD was elevated in the Navy as well as the Army and Marine Corps. PTSD rates also showed an increase for Air Force personnel since 2005. Given that Navy and Air Force servicemembers are less likely to engage in direct combat than personnel in the Army or Marine Corps, these findings suggest that factors other than combat experiences are playing a role in the development of PTSD in the military. Further research is needed to determine specific elements of deployment modification that may be useful in mitigating PTSD risk among Naval personnel and to identify the potential impact that conducting drone attacks may have on responsible Air Force personnel.

Other variables also predicted specific types of psychological problems. For instance, serving as an enlisted (E1 to E6) member of the military indicates risk for PTSD in these models but was not an independent risk factor for depression or suicidal ideation. Also, military women were at particular risk for current depression and PTSD. Those who were married or living with a partner who is not present at their current duty station were also at risk for depression.. These results point to the need for further study of preexisting differences that may exist among military personnel prior to active duty, potentially unique vulnerabilities of women in the military, and for research dedicated to revealing more information about risk factors for specific psychological disorders.

The current study's findings should be viewed in light of some limitations. First, although the 2008 survey achieved a response rate of 71% and data were weighted to adjust for nonresponse, the potential for response

bias still exists. The estimates cited here may underestimate the true prevalence of substance use and mental health outcomes that were examined. Second, the study's findings are based on self-reported data and are only as valid as participants are truthful. Self-report validity studies suggest that most people appear to be truthful when they believe that the research has a legitimate purpose, they have suitable privacy for providing their answers, they have assurances that their answers will be kept confidential, and they believe that those collecting the data can be trusted [21-23]. To encourage honest reporting we designed out study procedures to meet these requirements. Still, the possibility exists that these data are underreports of the true prevalence. Third, because of stigma associated with reporting mental health issues, respondents may have underreported the extent of these issues. Thus the prevalence rates reported here are likely to be conservative. Fourth, because of improvements in questionnaire wording from the 2005 to 2008 survey iterations, estimates of prescription drug misuse in 2005 and 2008 are not directly comparable to prior survey iterations. These changes are likely the combined result of real increases in the misuse of prescription drugs in the military, improvements in question wording, or both. Because of multiple potential explanations, the magnitude of these increases should be interpreted cautiously. Finally, because these data are based on self-reports, they may be subject to recall bias. Despite these limitations, the large number of respondents in the study, the use of sampling weights and nonresponse adjustments, the assured anonymity of the survey, and the consistency of the estimates in prior surveys from this series [12] suggest that the extent of this potential bias is likely to be minimal.

CONCLUSION

The long and challenging Iraq and Afghanistan wars are producing veterans who are at risk of developing substance use disorders and serious mental health problems, including PTSD. Military and governmental officials, researchers, and health care providers are working to address the surge in psychological and operational stress injuries observed among these returning troops. The screening for mental health and substance use problems and identification of changes in the numbers and groups at risk for such problems are a major concern. Planning for the optimal delivery of appropriate services is contingent on the quality of data from epidemiological studies designed to estimate the extent of these problems.

This paper has provided a general overview of the prevalence of substance use and mental health issues in current active United States military personnel, and a preliminary assessment of several risk factors associated with the development of common mental health conditions in military personnel. Findings suggest the need for further study by examining subgroups that may be at risk for developing negative mental health outcomes, and also by attempting to mitigate known risk factors for negative mental health outcomes.

In addition, more detailed investigation of the risk factors identified in this study is warranted, followed by the development and implementation of possible interventions to minimize identified risks. Other future directions for research include a thorough examination of pre-existing differences in military personnel who develop mental health and substance use issues pre- and post-deployment. Finally, future research must examine issues associated with psychiatric comorbidities and their interactions and identify drivers of substance abuse, especially prescription drug misuse.

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