Effects of Iraq/Afghanistan Deployments on Major Depression and Substance Use Disorder: Analysis of Active Duty Personnel in the US Military

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Objectives. Our objective was to analyze the association between deployment characteristics and diagnostic rates for major depression and substance use disorder among active duty personnel.

Methods. Using active duty personnel serving between 2001 and 2006 (n = 678 382) and deployment information from the Contingent Tracking System, we identified individuals diagnosed with substance use disorders and major depression from TRICARE health records. We performed logistic regression analysis to assess the effect of deployment location and length on these diagnostic rates.

Results. Increased odds of diagnosis with both conditions were associated with deployment to Iraq or Afghanistan compared with nondeployed personnel and with Army and Marine Corps personnel compared with Navy and Air Force personnel. Increases in the likelihood of either diagnosis with deployment length were only observed among Army personnel.

Conclusions. There were increased substance use disorders and major depression across services associated with combat conditions. It would be important to assess whether the public health system has adequate resources to handle the increasing need of mental health services in this population. (*Am J Public Health.* 2012;102:S80–S87. doi:10.2105/AJPH.2011.300425)

The continuing presence of the US military in Iraq and Afghanistan has posed substantial mental health challenges to US military service members and mental health care systems.[1–7] Much media attention and research effort have focused on posttraumatic stress disorder (PTSD) among US servicemen returning from Iraq and Afghanistan (Operations Iraqi Freedom and Operations Enduring Freedom [OIF/OEF]) and less on other mental health outcomes. However, there are other mental health conditions that are more likely to be diagnosed among the active duty population, such as a substance use disorder, major depression, anxiety, and traumatic brain injury. Reports by the Mental Health Advisory Team (MHAT) have noted that the percentage of soldiers reporting symptoms of major depression and substance use disorders has been rising over the years,[6,7] and a recent Rand report pointed out the need to study these conditions as part of the broad spectrum of postdeployment mental health consequences.[3]

Most of the studies on this topic used convenience samples and focused on soldiers and Marines, with little attention paid to Navy and Air Force personnel. Two studies using convenience samples of soldiers or Marines returning from Iraq found that about 20% of these personnel required mental health treatment, 15% had depression, and 10% to 12% reported having substance use disorder problems.[8,9] Reports by MHAT, also focusing on soldiers and Marines, noted an increasing rate of depression and overall mental health problems over the years, and that the rate was positively associated with combat level.[6,7] A similar finding was echoed in a recent study using a convenience sample of 1200 soldiers—the authors found that witnessing atrocities (between rival Iraqi factions) and experiencing a personal threat were associated with significantly higher rates of alcohol misuse.[10] The most recent MHAT report also noted that Army-enlisted personnel had higher rates of mental health problems than did Marine-enlisted personnel.[6] These studies, although providing important information on the prevalence of mental health problems of deployed active duty populations, did not provide appropriate comparison groups among the nondeployed. The lack of proper comparison groups complicated efforts to attribute observed mental health problems to specific deployment-related experiences without the capacity to investigate corresponding background rates among the nondeployed active duty population. Although PTSD was typically triggered by witnessing a traumatic event—which was also part of the criteria for being diagnosed with the condition—major depression and substance use disorder could often be triggered by other events among the nondeployed population.[11]

A few studies included the nondeployed population and had mixed findings. Research based on the Millennium Cohort Study (MCS),[12,13] which used self-administered surveys and tracked both active duty personnel and those separated from the military, compared health outcomes for those deployed in support of the Iraq and Afghanistan wars with those not deployed. The MCS found that men and women deployed with combat exposure had, respectively, 1.32 and 2.13 times the odds of having depression compared with those not deployed[14] and found weak evidence of any impact of a combat deployment on drinking outcomes among active duty respondents.[15] Besides the MCS, 1 study, using a 2008 Department of Defense Health Related Behaviors Survey, found that service members with any combat deployment had significantly higher rates of heavy alcohol and cigarette use.[16] Finally, a study that examined the New Jersey Army National Guard members found previous deployment to be significantly linked to a higher rate of major depression and higher probability of binge drinking.[17]

In summary, many earlier investigations focused just on health needs among the Army and the Marines. When studies included all Armed Services, none distinguished between possible different effects across services.[12,14–16] Recent literature on other mental health conditions (in particular, PTSD) found that the mental health condition rates and the deployment effects differed across services.[6,18] Lastly, almost all studies relied on self-administered survey questions to identify mental health problems, where self-reported answers were subject to errors and misreporting and could lead to misdiagnoses of the conditions.

The objective of our study was to analyze, for each service branch, the association between deployment characteristics (location and duration) and the rates of diagnosis for major depression and substance use disorder among the active duty population. We examined a random sample of all active duty enlisted personnel serving between 2001 and 2006, focusing on the percentage of personnel diagnosed with major depression and substance use disorder and analyzing the 2 conditions separately for the 4 military services: Army, Marines, Navy, and Air Force.

METHODS

We combined several data sources from TRICARE and the Defense Manpower Data Center to form the basis of our analysis. First, we identified the active duty personnel population and obtained demographic and service information (such as age, gender, race, and rank) from the Defense Enrollment Eligibility Reporting System (DEERS). Second, we identified the date that each mental health condition was first diagnosed and related health information from the following sources: the Standard Inpatient Data Record, the Standard Ambulatory Data Record, and the TRICARE encounter data from services rendered in managed care support contracted facilities. The 4 data sources allowed us to capture the diagnoses from both the inpatient and outpatient settings and from all civilian and military health providers. Third, we did a random draw for each service from the entire DEERS database to obtain a 25% sample, and we linked OIF/OEF deployment characteristics and military occupational specialty (MOS) codes between 2001 and 2006 from the Contingency Tracking System for this sample.

Our data consisted of 678 382 unique enlisted personnel from all services. This represented roughly a 25% sample of the active duty population. Among the sample, 49% was Army, 14% Marine, 20% Navy, and 17% Air Force. Our sample was representative of the US Armed Forces active duty enlisted population—Appendix A (data available as a supplement to the online version of this article at http://www.ajph.org) shows the comparison of key demographic variables and the percentage diagnosed with major depression and substance use disorders between the active duty population from the 100% DEERS database and our analytic sample.

Outcome Measures

We analyzed 2 mental health conditions separately. The dependent variable in the depression analysis was whether an enlisted person was diagnosed with major depression (if the *International Classification of Diseases-9* [*ICD-9*][19] code was either 296.2 or 296.3) anytime between 2001 and 2006.[11] Likewise, the substance use disorder analysis identified persons who were diagnosed with substance use disorder (if the first 3 digits of the *ICD-9* code was 291 or 292, 303, 304, 305) during the study period. Because we could only identify conditions through *ICD-9* codes, we did not have information on which type of drugs were identified as the misused substance.

Statistical Models

Our goal was to provide comparison of incidences of major depression and substance use disorders between the nondeployed service members and those deployed to certain locations while controlling for underlying demographic and service characteristics. We used logistic regression models to assess the effect of deployment location and duration under OIF/OEF on the rate of major depression and substance use disorder within each service. Our key variables of interest were the deployment locations and deployment durations based on information of the last deployment. For those who were diagnosed with either mental health condition, "last deployment" referred to the last deployment before the service member was diagnosed with the condition. For example, if a person was diagnosed with major depression on March 2004 and their most recent deployment before this date was July 2003, we used deployment information from the July 2003 deployment. We provided details of the location and the duration categories in the following. Covariates included service affiliation and demographic characteristics as explained in the following. All models were estimated using Stata 11.[20]

Explanatory Variables

There were 3 categories of variables included in the models: deployment characteristics, service characteristics, and demographic information. We classified 4 categories of deployment locations: not deployed under OEF or OIF (the reference group), deployed to Iraq or Afghanistan, deployed at other known locations under OEF or OIF (such as Kuwait, Qatar, Saudi Arabia, Turkey), and deployed to classified or unknown locations. For duration, we classified the deployment length into 3 categories: short, if the length of the last deployment was less than 120 days (the reference group); medium, if the length was between 120 and 180 days; and long, if the length was greater than 180 days.

For service characteristics, we included rank and MOS categories. We categorized MOS codes into the following categories: combat arms (reference group), combat support, combat service support, aviation, medical, and other MOS. The occupational categories were proxies for potential differences in job stress that might have influenced a service member's probability of being diagnosed with the mental health conditions, independent of the deployment effect. We included the following demographic information in the models to control for potential differences in major depression and substance use disorder rates across the demographic dimensions: gender, race/ethnicity (White as the reference group, African American, Hispanic, Asian, and other races), marital status, and age. In a sensitivity analysis, we replaced age with length of service, and the results were similar between the two specifications. Lastly, we included year indicators to control for possible macro trends in major depression and substance use disorder rates over the study period in the overall active duty population.

TABLE 1—Descriptive Statistics of Enlisted Personnel Deployment Characteristics, by Military Service Branch: 2001–2006

Deployment characteristics	Army, No. (%) or No.	Marines, No. (%) or No.	Navy, No. (%) or No.	Air Force, No. (%) or No.
Location of last OIF/OEF deployment				
Not deployed under OIF/OEF	257 873 (77%)	73 995 (75%)	86 754 (65%)	69 790 (62%)
Deployed to Afghanistan or Iraq	39 193 (12%)	8633 (9%)	1366 (1%)	5922 (5%)
Deployed to other nonclassified location	29 800 (9%)	11 586 (12%)	8556 (6%)	25 470 (23%)
Deployed to classified or unknown location	6682 (2%)	4310 (4%)	37 339 (28%)	11 113 (10%)
Duration of last OIF/OEF deployment among those that deployed				
Short (1–120 d)	91 885 (28%)	25 011 (25%)	42 106 (31%)	72 892 (65%)
Medium (120–180 d)	46 898 (14%)	25 644 (26%)	31 390 (23%)	27 590 (25%)
Long (more than 180 d)	194 796 (58%)	47 884 (49%)	60 499 (45%)	11 837 (11%)
Sample size	333 548	98 524	134 015	112 295

Note. OIF/OEF = Operations Iraqi Freedom and Operations Enduring Freedom.

RESULTS

Table 1 presents the descriptive statistics of the sample's deployment characteristics by service. The majority of the active duty personnel were not deployed under OIF/OEF: the percentages ranged from 62% in the Air Force to 77% in the Army. Not surprisingly, the Army and Marines had the highest share of enlisted members being sent to Iraq and Afghanistan (12% and 9%, respectively). The Navy only had 1% of its enlisted personnel deployed to Afghanistan or Iraq. The Navy had the highest share of its enlisted population being deployed to classified or unknown locations (28%), followed by the Air Force (10%). The Air Force appeared to serve a more supportive role, with 23% of their enlisted population being sent to known OIF/OEF missions other than Iraq andAfghanistan. Among those deployed, the Army and Marine Corps tended to have longer deployments: 58% and 49% of Army and Marine Corps personnel, respectively, had been deployed more than 180 days in their most recent deployment before being included in the sample, whereas 65% of deployed Air Force personnel had a tour length of less than 120 days.

Table 2 compares summary statistics of demographic and service characteristics by whether the service member was deployed to OIF/OEF. Although those deployed to OIF/OEF were similar on most dimensions to the control group, there were 2 notable differences: across all services, those deployed were more likely to be married and in the middle ranks (pay grade E4 and E5).

Table 3 presents the percentage of the active duty population who were diagnosed with each mental health condition by service. The top of Table 3 reports the rate of substance use disorder. The overall percentage of active duty population diagnosed with substance use disorder (regardless of deployment status) ranged from 6% in the Marine Corps to 9% in the Navy. Among the population diagnosed with a substance use disorder, 30% were because of alcohol use and 70% were because of drug use (see Appendix A; available online at http://www.ajph.org). In addition, 6% and 4% had major depression and PTSD as comorbid conditions, respectively (results not shown in Table 3). Deployment to Afghanistan and Iraq increased the incidence of substance use disorder substantially among Army and Marines Corps personnel: the rate of substance use disorder more than doubled in the Army (14.5% among those deployed to Afghanistan or Iraq vs 6% among the nondeployed; $P < .001$ in pairwise comparison) and almost doubled in the Marine Corps (9.3% vs 5%; $P < .001$). Among the small share of Navy personnel sent to Afghanistan or Iraq, their rate of substance use disorder diagnoses was comparable to the nondeployed Navy enlisted. A total of 7% of Air Force enlisted deployed to Iraq and Afghanistan were diagnosed with substance use disorder compared with 6% among the nondeployed population. Across all services, those deployed to other nonclassified OIF/OEF missions had similar substance use disorder rates as those deployed to Iraq or Afghanistan. Among Army and Air Force personnel, those deployed to classified or unknown locations actually had lower substance use disorder rates than did the nondeployed group. Lastly, among Army soldiers deployed under OIF/OEF, the substance use disorder rate, which was higher than that in the other 3 services, increased as the tour length increased. We did not observe this trend in the other 3 services.

The bottom of Table 3 reports the rates of major depression by the service. The overall rate of major depression was much lower than that of substance use disorder: it ranged from 1.7% for the Marines Corps to 3.3% for the Air Force. However, major depression was more likely to be accompanied by other comorbid conditions; 25% had substance use disorder as a comorbid condition and 18% had PTSD (results not shown in Table 3). The rate of major depression was substantially higher in the population deployed to Iraq, Afghanistan, or other known nonclassified locations under OIF/OEF compared with the nondeployed population. The rate of major depression did not appear to substantially differ across different deployment durations.

Table 4 presents results from the logistic regressions in terms of odds ratios (ORs) and focuses only on the effect of deployment characteristics (the complete results for all

TABLE 2—Descriptive Statistics of Enlisted Personnel Demographic and Service Characteristics, by Military Service Branch and Deployment Status to OIF/OEF: 2001–2006

	Army		Marines		Navy		Air Force	
	Not Deployed, % or No.	Deployed, % or No.	Not Deployed, % or No.	Deployed, % or No.	Not Deployed, % or No.	Deployed, % or No.	Not Deployed, % or No.	Deployed, % or No.
Demographic Characteristics								
Gender								
Male	88%	89%	96%	97%	86%	87%	82%	85%
Female	12%	11%	4%	3%	14%	13%	18%	15%
Marital status								
Single	57%	42%	74%	54%	60%	47%	54%	39%
Married	43%	58%	26%	46%	40%	53%	46%	61%
Race								
White	65%	61%	72%	68%	59%	55%	75%	73%
Black	19%	22%	10%	11%	21%	23%	15%	16%
Hispanic	7%	6%	8%	10%	7%	8%	3%	4%
Asian	4%	3%	3%	3%	6%	6%	2%	2%
Other races	6%	7%	7%	8%	8%	8%	5%	5%
Age	27	29	23	25	26	28	27	31
Service characteristics								
Military occupational specialty								
Combat arms	28%	28%	37%	38%	5%	5%	10%	10%
Combat support	11%	9%	16%	16%	9%	10%	0%	0%
Combat service support	26%	23%	27%	25%	5%	5%	75%	79%
Aviation			14%	15%	3%	3%		
Medical	10%	10%			3%	2%		
Other military occupational specialty	26%	30%	5%	5%	75%	74%	14%	10%
Rank								
E1–E3	41%	10%	70%	38%	48%	23%	45%	12%
E4	26%	37%	13%	30%	17%	25%	16%	24%
E5	15%	25%	9%	18%	17%	26%	19%	30%
E6	10%	16%	5%	7%	12%	17%	11%	19%
E7–E9	7%	11%	4%	7%	6%	10%	9%	16%
Sample size	294 814	88 614	80 373	27 275	97 378	52 821	84 285	51 149

Note. OIF/OEF = Operations Iraqi Freedom and Operations Enduring Freedom.

variables are included in the Appendix, available online at http://www.ajph.org). The top of Table 4 shows that deployment under OIF/OEF significantly increased the odds of having a substance use disorder compared with those not deployed, although the magnitude varied somewhat across the services and locations. Among Army enlisted personnel, the odds of being diagnosed with substance use disorder was 4.05 times higher among those deployed to Iraq/Afghanistan than it was among those not deployed under OIF/OEF (95% confidence interval [CI] = 3.82, 4.30). Being deployed on other known OIF/OEF missions also increased the odds of having a substance use disorder by the same magnitude (OR = 3.72; 95% CI = 3.53, 3.93). Being deployed to a classified or unknown location (2% of the Army enlisted) increased the odds by a much smaller magnitude, although the effect was still highly significant (OR = 1.26; 95% CI = 1.12,1.41). The effects of being deployed to Iraq or Afghanistan and on other known OIF/OEF missions were comparable for the Marines; the odds of developing PTSD increased by 4.36 (95% CI = 3.82, 4.97) and 3.12 (95% CI = 2.79, 3.48), respectively. Deployment to a classified or unknown location carried similar odds as the other locations for the enlisted Marines (OR = 3.03; 95% CI = 2.65, 3.47).

The effect of deployment location was much smaller for the Navy and the Air Force. For both, being deployed to Iraq or Afghanistan increased the odds of developing a substance use disorder by 1.8 times (95% CI = 1.56, 1.99) compared with those not deployed under OIF/OEF. For Navy personnel, being deployed to OIF/OEF locations other than Afghanistan or Iraq carried similar odds of having a substance use disorder (OR = 1.94; 95% CI = 1.78, 2.12 and OR = 1.82; 95% CI = 1.71, 1.94, for known and classified locations, respectively).

TABLE 3—Actual Percentage of Personnel Diagnosed With Substance Use Disorder and Major Depression, by Military Service Branch and Deployment Location and Length: 2001–2006

	Army, %, % (95% CI), or No.	Marines, %, % (95% CI), or No.	Navy, %, % (95% CI), or No.	Air Force, %, % (95% CI), or No.
Overall % diagnosed with substance use disorder	7.6%	6.0%	8.8%	6.1%
Based on location of last OIF/OEF deployment				
Not deployed under OIF/OEF	6.0 (6.0, 6.1)	5.0 (4.9, 5.2)	8.0 (7.8, 8.2)	5.9 (5.8, 6.1)
Deployed to Afghanistan or Iraq	14.8 (14.4,15.1)	9.3 (8.7, 9.9)	8.6 (7.2,10.2)	7.1 (6.5, 7.8)
Deployed to other nonclassified location	13.4 (13.0, 3.8)	8.6 (8.1, 9.2)	10.4 (9.8, 11.1)	7.1 (6.7, 7.4)
Deployed to classified or unknown location	4.9 (4.4,5.4)	8.7 (7.9, 9.6)	10.4 (10.1,10.8)	4.3 (3.9, 4.7)
Based on duration of Last OIF/OEF deployment				
Short (1–120 d)	11.2 (11.0, 11.9)	9.7 (9.0,10.5)	10.3 (9.8, 10.8)	6.1 (5.8, 6.3)
Medium (120–180 d)	12.6 (12.3, 13.5)	8.2 (7.6, 8.9)	10.9 (10.4, 11.5)	7.0 (6.5, 7.5)
Long (more than 180 d)	14.4 (14.1, 14.7)	8.8 (8.3, 9.3)	10.2 (9.8, 10.6)	6.5 (5.8,7.2)
Overall % diagnosed with major depression	2.5%	1.7%	2.4%	3.3%
Based on location of last OIF/OEF deployment				
Not deployed under OIF/OEF	1.7 (1.7, 1.8)	1.2 (1.1, 1.2)	2.2 (2.1, 2.3)	3.1 (3.0, 3.3)
Deployed to Afghanistan or Iraq	5.1 (4.9, 5.3)	3.8 (3.4, 4.2)	5.8 (4.6, 7.0)	3.5 (3.0, 4.0)
Deployed to other nonclassified location	5.7 (5.5, 6.0)	3.6 (3.2, 3.9)	3.5 (3.1, 3.9)	3.9 (3.6, 4.1)
Deployed to classified or unknown location	2.5 (2.2, 2.9)	2.3 (1.8, 2.7)	2.4 (2.3, 2.6)	2.3 (2.1, 2.6)
Based on duration of last OIF/OEF deployment				
Short (1–120 d)	4.6 (4.4, 5.0)	3.6 (3.1, 4.1)	2.7 (2.4, 3.0)	3.3 (3.1, 3.5)
Medium (120–180 d)	4.5 (4.2, 5.0)	3.5 (3.0, 3.9)	2.8 (2.5, 3.1)	3.8 (3.4, 4.2)
Long (more than 180 d)	5.4 (5.3, 5.7)	3.3 (3.0, 3.6)	2.7 (2.5, 2.9)	3.5 (3.0, 4.1)
Sample size	333 548	98 524	134 015	112 295

Note. OIF/OEF = Operations Iraqi Freedom and Operations Enduring Freedom.

For the Air Force, deployments to nonclassified locations increased the risk of having a substance use disorder by 1.62 times (95% CI=1.51, 1.75), but deployments to a classified or unknown location did not affect the risk of having a substance use disorder.

Deployment duration appeared to be associated with substance use disorder diagnoses only among Army personnel. Compared with those who had a short tour length (<120 days), Army soldiers whose last deployment was between 120 and 180 days were 1.08 times more likely to be diagnosed later with substance use disorder (95% CI=1.00, 1.16), and those whose last deployment was more than 180 days had an OR of 1.31 (95% CI=1.24, 1.39). A long deployment duration did not significantly increase the odds of having a substance use disorder for the other 3 services.

Although not the focus of this study, it was worth highlighting results of a few demographic and service variables. Appendix B (available as a supplement to the online article at http://www.ajph.org) shows that among the broad categories of MOS, enlisted personnel whose specialty was in the category combat arms had the highest odds of developing a substance use disorder. In general, being in a lower rank was associated with higher odds of having a substance use disorder, as was being White (compared with other racial/ethnic groups).

Table 4 shows the results from the major depression analysis (full results in Appendix C, available as a supplement to the online version of the article at http://www.ajph.org). Deployment to Iraq or Afghanistan was associated with higher odds of major depression. The highest OR was observed for the Marines (OR=4.51; 95% CI=3.66, 5.57), and the lowest OR was observed for the Air Force (OR=1.45; 95% CI=1.22, 1.72). Deployments to other nonclassified locations were also associated with higher odds of major depression, although the magnitude was lower for the Navy (OR=3.25; 95% CI=2.5, 4.22, for deployment to Afghanistan and Iraq; OR=1.92; 95% CI=1.64, 2.24 for nonclassified locations). The ORs for classified or unknown locations were lower (OR ranged from 0.97 to 2 depending on the service), although these were still statistically significant for all services, except for the Air Force. Another result worth highlighting was that women had a much higher odds of developing major depression compared with men (see Appendix C, available online at http://www.ajph.org): the OR ranged from 4.04 for the Army to 7.71 for the Marines. Similarly, being married was also associated with a higher risk of major depression across all services. Lastly, in a sensitivity analysis, we analyzed alcohol and drug use disorders separately and found similarly strong associations between deployment location and either condition (Appendix D, available as a supplement to the online version of the article at http://www.ajph.org).

TABLE 4—Effect of Last Deployment's Location and Duration on the Rate of Substance Use Disorder and Major Depression, 2001–2006

	Army, OR (95% CI)	Marines, OR (95% CI)	Navy, OR (95% CI)	Air Force, OR (95% CI)
Substance use disorder				
Location of last deployment (reference group is not deployed under OIF/OEF)				
Deployed to Afghanistan or Iraq	4.05*** (3.82, 4.30)	4.36*** (3.82, 4.97)	1.77*** (1.45, 2.16)	1.76*** (1.56, 1.99)
Deployed to other nonclassified location	3.72*** (3.53, 3.93)	3.12*** (2.79, 3.48)	1.94*** (1.78, 2.12)	1.62*** (1.51, 1.75)
Deployed to classified or unknown location	1.26*** (1.12, 1.41)	3.03*** (2.65, 3.47)	1.82*** (1.71, 1.94)	1.05 (0.94,1.16)
Duration of last deployment (reference group is short [<120 d])				
Medium (120–180 d)	1.08** (1.00,1.16)	0.82*** (0.73, 0.93)	1.12*** (1.03, 1.21)	1.16*** (1.05,1.27)
Long (longer than 180 d)	1.31*** (1.24, 1.39)	0.92 (0.82,1.03)	1.06* (0.99, 1.14)	1.11 (0.97,1.27)
Major depression				
Location of last deployment (reference group is not deployed under OIF/OEF)				
Deployed to Afghanistan or Iraq	3.52*** (3.21, 3.86)	4.51*** (3.66, 5.57)	3.25*** (2.50, 4.22)	1.45*** (1.22,1.72)
Deployed to other nonclassified location	3.91*** (3.60, 4.24)	3.13*** (2.62, 3.74)	1.92*** (1.64, 2.24)	1.50*** (1.36,1.66)
Deployed to classified or unknown location	1.56*** (1.32, 1.83)	2.00*** (1.57, 2.55)	1.39*** (1.22, 1.57)	0.97 (0.84,1.11)
Duration of last deployment (reference group is short [<120 d])				
Medium (120–180 d)	0.94 (0.84, 1.05)	1.01 (0.83, 1.23)	1.03 (0.88,1.20)	1.20*** (1.06,1.37)
Long (longer than 180 d)	1.20*** (1.10, 1.30)	0.89 (0.74, 1.07)	0.98 (0.86,1.12)	1.16* (0.97,1.38)
Sample size	333 548	98 524	134 015	112 295

Note. OIF/OEF = Operations Iraqi Freedom and Operations Enduring Freedom.
*P < .1; **P < .05; ***P < .01.

DISCUSSION

In this study, we found that in general, deployment under OIF/OEF increased the risks of being diagnosed with both substance use disorder and major depression substantially, although the magnitudes of the effects varied somewhat across services and across deployment locations. Deployment length, by contrast, was not strongly associated with these 2 mental health conditions, except among Army personnel. However, even in that case, the magnitude of the effect was much smaller than the magnitude of the effect because of deployment locations.

Our study provided valuable insight for the mental health readiness of the US Armed Services and implications for potential, continued support of ongoing operations and their post deployment health care needs. The Military Health System is currently a key focal point of military budget reviews; therefore, this study contributed important information to identify the need for sustained support of the services.

This study had a few limitations. First, our data did not allow for assessment of level of combat exposure. Therefore, we were unable to ascertain whether the adverse effect was because of deployment to a combat zone itself or because of direct combat exposure. We instead used the deployment location of Iraq and Afghanistan as a proxy for higher levels of combat stress, because troops deployed to OEF and OIF had increased likelihood of combat exposures compared with other deployed populations.[3]

Second, although we were able to include MOS, we did not have details on the specific assignments for any given deployment. Such details on assignment might provide additional insight on the underlying causes of adverse effects of deployments. Third, although our sample was representative of those who ever served in the US Armed Forces between 2001 and 2006, we most likely missed the more severe cases of the mental health conditions because those would show up in the VA system unless they were first diagnosed inside the TRICARE system. As a result, our overall percentages of major depression and substance use disorders understated the overall prevalence of the conditions, especially among the veteran population. Fourth, although we had the full deployment information of OIF/OEF missions, we were unable to capture other missions (e.g., those deployed to non-OIF/OEF missions, such as deployment to Haiti or Cuba, who would be in our control group). This likely made our estimated effects of deployment a conservative estimate, because the actual rate of major depression and substance use disorder was likely lower in the strictly nondeployed population.

Third, our sample was representative of all active duty personnel who served in the US Armed Forces between 2001 and 2006, including those who left the service but were eligible for TRICARE coverage for some part of the study period. TRICARE is the health care system of the Department of Defense that serves all uniformed services, activated National Guard and Reserve, retired military, and their families worldwide. Service members are automatically eligible for and enrolled in TRICARE when they remain on active duty. When veterans are separated from the military under other than dishonorable conditions, their health care is no longer provided by TRICARE but provided by the Department of Veterans Affairs (VA) health care system. Although we captured mental health status among recent veterans to include those who had diagnosed mental health problems while

on active service, this was not a study of the general veteran population who were diagnosed in the VA health care system after separation from service. Although the military has implemented educational programs to reduce the amount of stigma associated with mental illness, such as the Army Campaign Plan for Health Promotion, Risk Reduction and Suicide Prevention, and the Suicide Prevention Council, our study could not address the extent to which mental health conditions remained undiagnosed among the active duty population who avoided seeking mental health treatment because of the stigma surrounding their illness.

Last, using clinical diagnoses likely underestimated the true rate of depression and substance use disorders among the active duty population because of underreporting as a result of the stigma associated with seeking mental health treatment—24% of enlisted members from OEF surveyed by MHAT in 2009 believed that seeking mental health care services would harm their careers (30% among those serving in OIF), and 30% among those in OEF (40% in OIF) believed that it would result in differential treatment by unit leadership and lost of confidence by unit members.[21,22] The degree of underreporting might be higher among those not deployed, because the deployed personnel were required to complete the Post-Deployment Health Assessment (PDHA), which screened for mental health problems and made referrals for treatment if needed. However, we did not expect the degree of underreporting to introduce any significant bias in our estimates for several reasons. For one, PDHA is administered to all deployed personnel, not just those deployed to OIF/OEF, so some of our control groups were also subject to the screening process. In addition, although PDHA was designed to screen for potential PTSD cases, it was not designed to explicitly screen for major depression and substance use disorder. Before the PDHA revision in April 2007, there was only 1 question related to depression as part of the PTSD screening, and 1 question related to whether a person was interested in receiving help for an alcohol problem.

With these caveats in mind, it was useful to compare our results to those from the MCS—the other major research effort that tracked population-based military cohort's health outcomes using self-administered surveys. It was not surprising that our overall rates of depression and substance use disorder because of alcohol were lower than those reported in MCS, because MCS identified conditions through surveys, whereas we identified conditions through TRICARE health records. The overall rate of new onset of depression in MCS was 4% (Wells et al[14]; Tables 2 and 3), whereas our overall rate of major depression was 2% (see the online appendixes, available at http://www.ajph.org). Note, however, MCS used screening questions that captured a broader spectrum of depression, whereas our clinical diagnoses were limited to just major depression. MCS did not have measures to capture drug use disorders, but reported percentages of respondents with drinking problems. By contrast, our analysis found a much higher OR associated with deployment to Afghanistan or Iraq (i.e., deployed with combat exposures) for both conditions compared with the MCS findings.[14,15]

It was not surprising that deployment to Iraq and Afghanistan increased the odds of major depression and substance use disorders among service members, given that the combat exposure levels in those 2 locations were much higher in other locations. The magnitude of the adverse effect, however, was substantial, especially among those engaged in ground battle. The fact that we observed the largest adverse effect of deployment locations among Army and Marines likely reflected the different levels of direct combat exposure across services. Our calculations from the PDHA from the same time period showed that Army and Marine enlisted members had a much higher rate of seeing individuals killed during deployment or being inside destroyed vehicles compared with the Navy and Air Force. Other studies using the PDHA also documented that the majority of physical injuries from OIF occurred among Marine Corps personnel, followed by the Army.[23]The lower odds associated with classified location deployments might be caused by selection: those who were selected for covert operations might have been originally selected partly for having a stronger mental health readiness than the general deployed population; furthermore, they might have undergone better preparation and training. However, it was important to note that even among those deployed to the classified or unknown locations, the rate of both having a substance use disorder and major depression was still higher than that of the nondeployed population. The study also revealed a substantially higher risk of major depression among the female enlisted personnel, especially in the Marine Corps. This finding was consistent with previous literature that found that women had a higher likelihood of reporting symptoms of depression.[12,24,25] We could not ascertain, however, whether this might be because women more actively sought treatment of the depression symptoms, or that they were more likely to develop major depression in the military environment. However, evidence on gender and depression suggested that women were not more likely to seek treatment.[25]

Major depression and substance use disorders both require long-term treatment, and pose a substantial health care cost as well as psychological and social costs to the individual and society.[3,26,27] It is important for future research to link actual detailed combat experience and intensity to clinical data to better identify the types of combat experiences and environments that are triggers for these mental health conditions. Such insight would contribute to the design of training programs that can better mentally prepare the enlisted for their deployment assignments. Given the continuing US military presence in Afghanistan and other parts of the world, and the increasing trend in major mental health conditions reported in the US military, it would be important for the Department of Defense to assess whether the current system has adequate resources and manpower to handle the increasing number of active duty personnel who need mental health services. ■

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Contributors

Y. Shen conceptualized the study concept and design, analyzed the data, performed the statistical analysis, drafted the article, and supervised the study. Y. Shen and T.V. Williams acquired the data and performed administration, technical, and material support. Y. Shen and J. Arkes obtained the funding. T.V. Williams and J. Arkes critically revised the article for important intellectual content. All three authors interpreted the data.

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Human Participant Protection

The study was approved by the Naval Postgraduate School's Institutional Review Board, TRICARE Management Activity privacy board, and the Office of Navy Medicine.

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