



FEBRUARY 2012

Volume 19
Number 2

MISMIR

MEDICAL SURVEILLANCE MONTHLY REPORT



PAGE 2 Health care experiences prior to suicide and self-inflicted injury, active component, U.S. Armed Forces, 2001-2010

Lily Trofimovich, MS; Nancy A. Skopp, PhD; David D. Luxton, PhD; Mark A. Reger, PhD



PAGE 7 Relations between suicide and traumatic brain injury, psychiatric diagnoses, and relationship problems, active component, U.S. Armed Forces, 2001-2009

Nancy A. Skopp, PhD; Lily Trofimovich, MS; Jamie Grimes, MD; Lynne Oetjen-Gerdes, PhD; Gregory A. Gahm, PhD

PAGE 12 Outpatient encounters associated with diagnostic codes for migraine and other types of headaches, active component service members, 1998-2010

PAGE 18 Medical evacuations from Operation Iraqi Freedom/Operation New Dawn, active and reserve components, U.S. Armed Forces, 2003-2011

PAGE 22 Surveillance snapshot: Medical evacuations from Operation Enduring Freedom (OEF), active and reserve components, U.S. Armed Forces, October 2001-December 2011

PAGE 23 Surveillance snapshot: Recurrent medical encounters associated with alcohol abuse-related diagnostic codes, active component, U.S. Armed Forces, 2001-2010

SUMMARY TABLES AND FIGURES

PAGE 24 Deployment-related conditions of special surveillance interest



Health Care Experiences Prior to Suicide and Self-inflicted Injury, Active Component, U.S. Armed Forces, 2001-2010

Lily Trofimovich, MS; Nancy A. Skopp, PhD; David D. Luxton, PhD; Mark A. Reger, PhD

Suicide is a leading cause of deaths of U.S. service members. Medical care providers may play a role in suicide prevention. We summarized the outpatient experiences of service members prior to suicide or self-inflicted injury and compared them with service members without suicidal behavior. During 2001-2010, 45 percent of individuals who completed suicide and 75 percent of those who injured themselves had outpatient encounters within 30 days prior to suicide/self-harm. Primary care was the most frequently visited clinical service prior to suicide/self-harm. As compared to their counterparts, service members with suicidal behavior had especially excessive outpatient visit rates within, but not prior to, 60 days of their deaths/injuries. The finding suggests that there may be one or more “triggering” events that lead to care-seeking. These results may help identify individuals that should be screened for suicide risk.

Suicide is the third leading cause of deaths of U.S. service members after traffic accidents and war.¹ Since the beginning of combat operations in Iraq and Afghanistan, the number of suicides among U.S. military members has increased. The estimated suicide rate among U.S. Army soldiers nearly doubled from 2004 to 2008 (10.8 to 20.2 per 100,000);^{2,3} the rate is higher than the adjusted suicide rate among civilians.

In civilian studies, a significant proportion of individuals who died by suicide were seen in health care clinics in close proximity to their suicides; an estimated 45 percent of individuals with completed suicides had encounters with health care providers within one month prior to their deaths.⁴ Gillmore and Chan highlight the potentially important roles that medical care providers may play in suicide prevention;⁵ such interventions are enabled by increased awareness of suicide risk factors and knowledge of common demographics among individuals who die by suicide. In the same vein, Sudak et al. suggest that standardized curricula designed by suicide

experts and provided to resident physicians might reduce morbidity and mortality.⁶

Several studies among civilians have indicated that suicide decedents were more frequent users of medical care than age- and sex-matched controls. During the year prior to their deaths, suicide cases were more likely than controls to have contact with mental health specialists or emergency departments.⁷⁻⁹ Powers et al. found that compared to controls, suicide decedents visited general practitioners more frequently during one year prior, but not one month prior to suicide.¹⁰

The numbers, natures, and timing of health care encounters among individuals who later die by suicide have not been examined in the U.S. military population. This report summarizes the outpatient experiences of service members prior to suicide or self-inflicted injury and compares them to those of service members without suicidal behavior. To this end, the report evaluates frequencies and rates of visits to outpatient clinics and the timing of these visits in relationship to eventual suicide or self-inflicted injury.

METHODS

The surveillance period was January 2001 to December 2010. The surveillance population was comprised of all individuals who served in an active component of the Army, Navy, Air Force or Marine Corps any time during the surveillance period. Death and medical records maintained in the Defense Medical Surveillance System and the DoD Medical Mortality Registry were used to identify three retrospective cohorts. (For the remainder of this report, these cohorts are referred to as the “suicide/self-harm” cohorts.):

Suicide cohort: Service members who died by suicide were identified from death records maintained by the Office of the Armed Forces Medical Examiner.

Self-inflicted injury cohort: Service members who were affected by self-inflicted injuries were identified from a) records of hospitalizations and ambulatory visits with “external cause of injury” codes (E-codes) indicative of self-inflicted injury or poisoning (ICD-9-CM: E950-E958) in any diagnostic position; and b) records of injury-related hospitalizations with NATO Standard Agreement (STANAG) “general class of trauma” codes indicative of injuries that were “intentionally self-inflicted.” For each affected service member, only the first self-inflicted injury-specific encounter was used for analyses regardless of the number of such encounters during the surveillance period.

Likely self-harm cohort: Patrick and colleagues reported that the combination of injury/poisoning and mental disorder diagnoses on hospital discharge records was a strong indicator of “self-harm.”¹¹ In turn, for this analysis, the “likely self-harm” cohort was comprised of service members who were hospitalized for an injury or poisoning (with no indication of intentional self-harm) and had a mental disorder diagnosis (ICD-9-CM: 290-319) during the

same hospitalization. Injury/poisoning-related hospitalizations caused by accidents (ICD-9-CM: E800-E848, E850-E869) or “adverse effects of drugs properly administered” (ICD-9-CM: E930-E949) were not considered likely self-harm-defining events.

For members of each suicide/self-harm cohort, all of their ambulatory visits (in U.S. military medical facilities and from purchased care providers) within two years prior to their cohort-defining events were grouped by the timing of the visits in relation to the events: 0-30 days, 31-60 days, 61-90 days, 91-180 days, 181-360 days, and 361-720 days preceding the events.

To detect patterns of outpatient care potentially related to suicide risk, the outpatient experiences of each suicide/self-harm cohort were compared against those of matched referent cohorts. For this purpose, referent cohort members were individually matched to suicide/self-harm cohort members on gender, age group (within 1 year), service branch, and length of service (within 6 months); in addition, referent cohort members had no record of suicidal behavior and were in service in the active component on the day of the cohort-defining event of their index cohort member.

Outcomes of interest during analyses were a) the rates of cohort members who received outpatient care from various clinical services (e.g., primary care) or medical specialty clinics (e.g., psychiatry) at various times prior to their cohort-defining events; and b) differences between each suicide/self-harm and its referent cohort regarding rates of ambulatory visits, by clinical service/medical specialty type, during various time intervals prior to their respective cohort-defining events. The clinical services/medical specialties of outpatient clinics in U.S. military medical facilities were documented with Medical Expense and Reporting System (MEPRS) codes. Because the natures of clinics in non-military facilities were not specified in available records, outpatient visits in non-military facilities were characterized as “non-military facility” visits. Only one outpatient visit per clinical service/medical specialty type per day was counted for each individual.

“Excess incidence” rates of outpatient visits by each suicide/self-harm cohort were estimated by subtracting the rates of visits – to each clinic type during each period of interest – in each referent cohort from the corresponding rates in the respective suicide/self-harm cohort. Relatively high or increasing “excess incidence” rates of outpatient visits to specific clinical services/medical specialty clinics, especially during periods just prior to suicide/self-harm events, were considered potential indicators of high or increasing suicide, self-inflicted injury, or self-harm risk.

RESULTS

During 2001-2010, 1,939 service members completed suicide; 19,955 were diagnosed with self-inflicted injuries; and 3,463 were hospitalized for injuries/poisonings that were “likely self-harm” related (i.e., diagnoses of an injury/poisoning and mental disorder during the same hospitalization) (Table 1).

Compared to self-inflicted injury and likely self-harm cohort members, suicide victims were much more often males and older than 29 years. The ratio of completed suicides to self-inflicted injuries plus likely

self-harm cases sharply increased with increasing age. Approximately two-thirds of service members in each suicide/self-harm cohort were in the Army or Marine Corps (Table 1).

Outpatient clinic visits prior to suicidal behavior among suicide/self-harm cohorts

Of those who died from suicide, 45 percent had an outpatient visit within 30 days prior to their deaths; in contrast, approximately three-fourths of those in the self-inflicted injury (73%) and likely self-harm (76%) cohorts had outpatient encounters within 30 days prior to their cohort-defining events (Table 2).

Among all three suicide/self-harm cohorts, “primary care” was the most frequently visited clinical service/medical specialty during the month prior to their cohort-defining events. The proportions of suicide cases who visited mental health (4.4%), psychiatry (2.9%) and psychology (2.0%) specialty clinics within one month of their deaths were only one-third to one-fifth of the respective proportions among members of the self-inflicted injury and likely self-harm cohorts (Table 2).

TABLE 1. Demographic and military characteristics of service members in suicide/self-harm cohorts, active component, U.S. Armed Forces, 2001-2010

	Suicide		Self-inflicted injury ^a		Likely self-harm ^b	
	No.	%	No.	%	No.	%
Total	1,939		19,955		3,463	
Service						
Army	864	44.6	10,995	55.1	1,747	50.5
Navy	380	19.6	3,856	19.3	585	16.9
Air Force	389	15.8	2,894	14.5	566	16.3
Marine Corps	306	20.1	2,210	11.1	565	16.3
Sex						
Female	79	4.1	5,373	26.9	799	23.1
Male	1,860	95.9	14,581	73.1	2,664	76.9
Age						
<20	174	9.0	4,369	21.9	564	16.3
20-24	787	40.6	10,160	50.9	1,544	44.6
25-29	433	22.4	3,251	16.3	682	19.7
30-34	215	11.1	1,197	6.0	293	8.5
35-39	188	9.7	630	3.2	220	6.4
40+	140	7.2	347	1.7	160	4.6

^aInpatient or outpatient diagnosis of an intentionally self-inflicted injury or poisoning
^bHospitalization for injury or poisoning with a concurrent mental health diagnosis

TABLE 2. Numbers and proportions of service members in suicide/self-harm cohorts who visited outpatient clinics during the 30 days prior to their cohort-defining events, among clinics visited by at least 1% of suicide completers, active component, U.S. Armed Forces, 2001-2010

Outpatient clinic type	Suicide		Self-inflicted injury ^a		Likely self-harm ^b	
	No.	%	No.	%	No.	%
Any outpatient clinic	876	45.2	14,637	73.4	2,626	75.8
Primary care	318	16.5	5,796	29.2	1,015	29.5
Family practice	187	9.7	2,495	12.6	468	13.6
Non-military facility	157	8.2	2,650	13.3	811	23.6
Emergency medical	135	7.0	2,911	14.6	405	11.8
Optometry	102	5.3	1,647	8.3	276	8.0
Substance abuse	90	4.7	2,181	11.0	350	10.2
Physical therapy	89	4.6	1,443	7.3	430	12.5
Hearing conservation	89	4.6	1,319	6.6	223	6.5
Mental health	85	4.4	2,948	14.8	535	15.5
Immunizations	72	3.7	1,133	5.7	182	5.3
Social work	57	3.0	1,180	5.9	210	6.1
Psychiatry	55	2.9	3,035	15.3	459	13.3
Flight medicine	52	2.7	398	2.0	109	3.2
Community health	48	2.5	751	3.8	123	3.6
Psychology	38	2.0	1,565	7.9	239	6.9
Orthopedic	37	1.9	655	3.3	190	5.5
Medical examination	24	1.2	629	3.2	98	2.8
Occupational health	23	1.2	896	4.5	164	4.8
General surgery	23	1.2	247	1.2	98	2.8
Internal medicine	22	1.1	569	2.9	110	3.2
Audiology	22	1.1	290	1.5	50	1.5
Immediate care	21	1.1	629	3.2	73	2.1
Neurology	18	0.9	203	1.0	54	1.6

^aInpatient or outpatient diagnosis of an intentionally self-inflicted injury or poisoning

^bHospitalization for injury or poisoning with a concurrent mental health diagnosis

Outpatient clinic types with excessive visits

During the 30 days prior to their deaths, suicide cases (compared to their referent) had higher rates of visits to approximately three-fourths (77%) of the 64 clinical services/medical specialties visited overall. The clinic types for which visit rates were most excessive among suicide cases compared to referent cohort members were “non-military facilities” (i.e., outsourced care), family practice, substance abuse, and emergency medical (Figure 1a).

During the 30 days prior to their injuries, the self-inflicted injury cohort (compared to their referent) had higher rates of visits to 89 of 96 (88%) clinical services/medical specialties visited overall. Among self-inflicted injury cohort members, outpatient visit rates were most excessive to psychiatry, mental health, non-military facility, substance abuse and emergency medical clinics (Figure 1b).

During the 30 days prior to their hospitalizations, the likely self-harm cohort (compared to their referent) had higher rates of visits to 71 of 74 (96%) clinical services/medical specialties visited overall. Among likely self-harm cohort members, outpatient visit rates were most excessive to non-military facilities, psychiatry, mental health, primary care, substance abuse and physical therapy clinics (Figure 1c).

Of note, among members of all three suicide/self-harm cohorts together, the most frequent primary diagnoses during visits to non-military facilities were musculoskeletal disorders (e.g., back pain) (19.3%), “signs, symptoms and ill-defined conditions” (16.8%), injuries (15.1%) and mental disorders (9.3%) (data not shown).

Excess visits by time period

In general, in each suicide/self-harm cohort (compared to their respective

referents), outpatient visit rates were most excessive within the 60 days prior to their cohort-defining events. Moreover, the magnitudes of differences in rates to many clinical services and medical specialty types sharply increased during the 0-60 day period, compared to more remote periods, prior to cohort-defining events. In contrast to the general finding, suicide cases had relatively high rates of visits to primary care clinics within 30 days – but relatively low rates of primary care clinic visits within 30-60 days – prior to their deaths (Figures 2a-c).

EDITORIAL COMMENT

This report documents that U.S. service members who die by suicide or engage in other self-harm behaviors are very similar to their counterparts in terms of health care use prior to, but not within, 60 days or so of their deaths/injuries. The finding suggests that there may be one or more “triggering” events during which thoughts of self-harm intensify and lead to increased health care usage in many clinical service settings. A few hypotheses shed light on these findings. Distressed service members may seek health care services in the hope that clinicians might recognize or help ameliorate the distress. In this analysis, service members with suicidal behavior as compared to their referent cohorts had higher rates of visits to most clinic types, including family practice and primary care; many service members seek help for psychosocial problems in primary care settings, perhaps because they are less stigmatizing than behavioral health settings. It is also possible that service members with significant health problems experience feelings of hopelessness and contemplate ending their lives. Another possibility is that service members seek medications in health care clinics for the purpose of self-poisoning.

Suicide cases were found to have higher rates of outpatient visits during the month prior to suicide than similar groups of service members who did not complete suicide. The most frequented clinic type was primary care. Some of these visits may

FIGURE 1A. Rate difference (“excess incidence”) in outpatient clinic visits among suicide cases vs. referents, during the 30 days prior to suicide

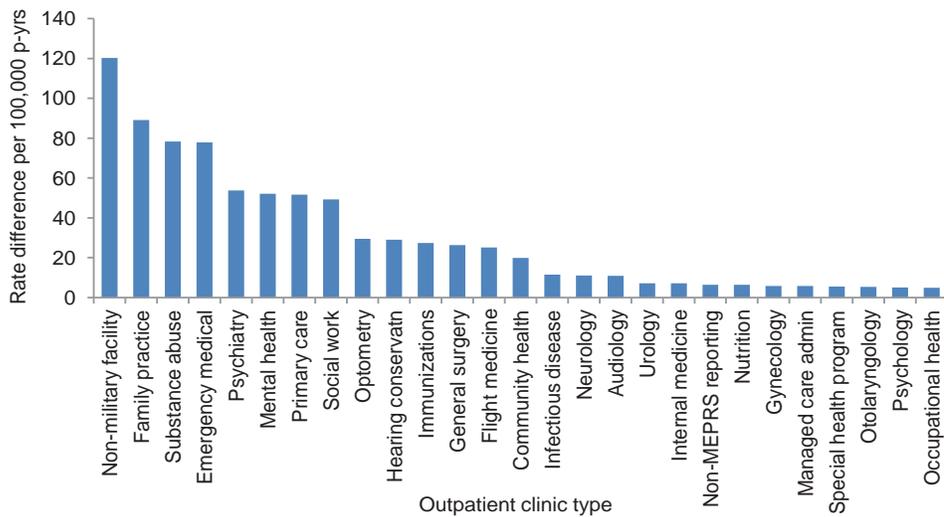


FIGURE 1B. Rate difference (“excess incidence”) in outpatient clinic visits among service members with self-inflicted injury vs. referents, during the 30 days prior to injury

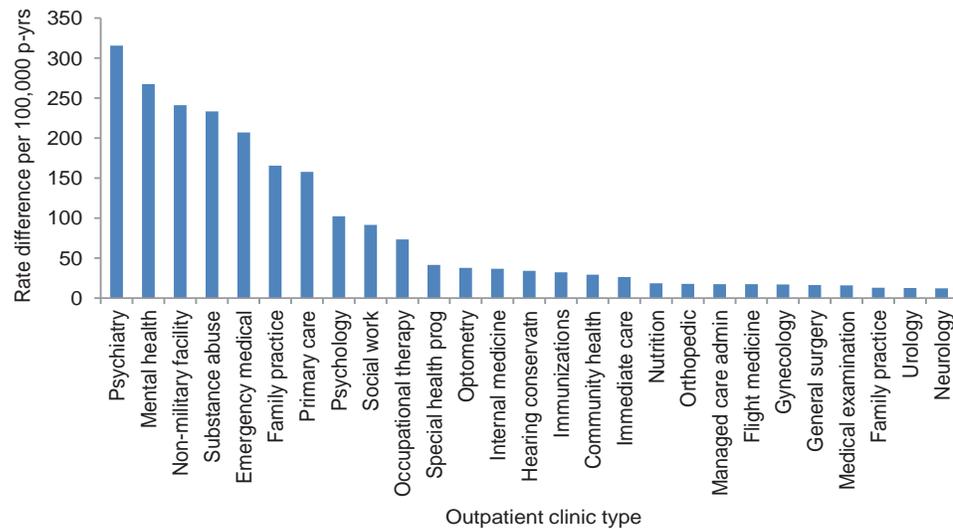
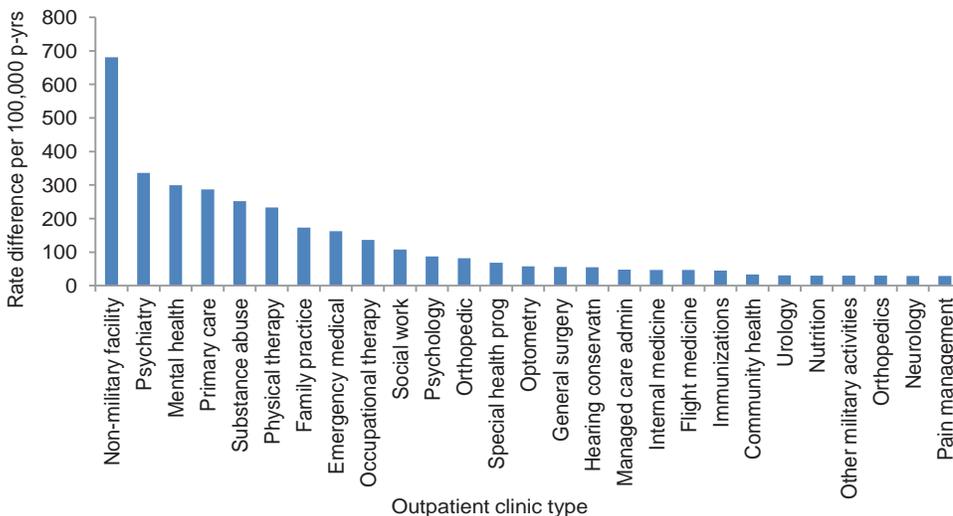


FIGURE 1C. Rate difference (“excess incidence”) in outpatient clinic visits among service members with “likely self-harm” vs. referents, during the 30 days prior to self-harm



represent a final call for help by individuals who have made specific plans to end their lives. The excess visits might also represent the somatization of distress and related problems such as sleep deprivation. However, the majority (55%) of suicide completers did not present to any outpatient clinic during the 30 days prior to suicide. Overall, the frequency of health care visits among service member suicide decedents mirrors that among civilians.⁴

Interestingly, approximately three-quarters of individuals with medical records of self-inflicted injury or likely self-harm visited an outpatient clinic during the month prior to their injury event. As compared with suicide completers, higher proportions of service members with self-inflicted injury and self-harm-related medical visits sought care in mental health and psychiatry clinics. These service members may represent a group of suicide contemplators who use less lethal forms of self-harm and may also reflect qualitative differences between service members who complete suicide and those who engage in self-harm. For example, certain psychiatric problems may be accompanied by parasuicidal behaviors. These suppositions, however, should be considered provisional and await empirical validation.

There are some limitations to this analysis that should be noted. The causal codes used to identify the self-inflicted injury cohort specified that the injuries were intentionally inflicted; however, it is unclear whether the intent was suicide or self-harm without intent to die (e.g., skin cutting). In addition, the validity of the criteria used to define the self-inflicted injury and self-harm cohorts are unknown. The completeness and accuracy of reporting of relevant “external causes of injury” (ICD-9-CM E-codes) by medical providers is unknown.

Overall, the finding that the outpatient records of individuals who complete suicide or harm themselves are most distinguishable from those of other service members during the 0-60 day window prior to the suicide/self-harm event indicates that there may be a particular window of opportunity to intervene and potentially prevent service member suicides. It may also be possible to

FIGURE 2A. Rate difference (“excess incidence”) in outpatient clinic visits among suicide cases vs. referents, by time period prior to suicide

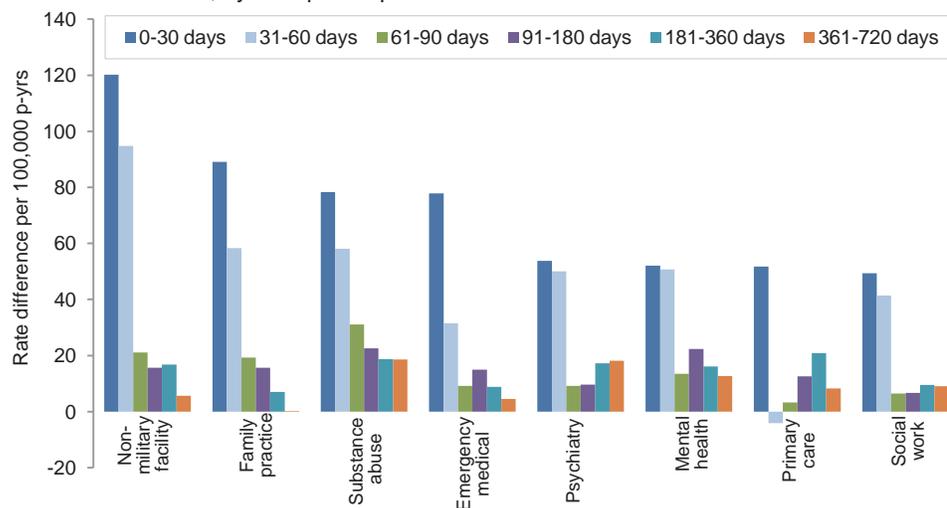


FIGURE 2B. Rate difference (“excess incidence”) in outpatient clinic visits among service members with self-inflicted injury vs. referents, by time period prior to injury

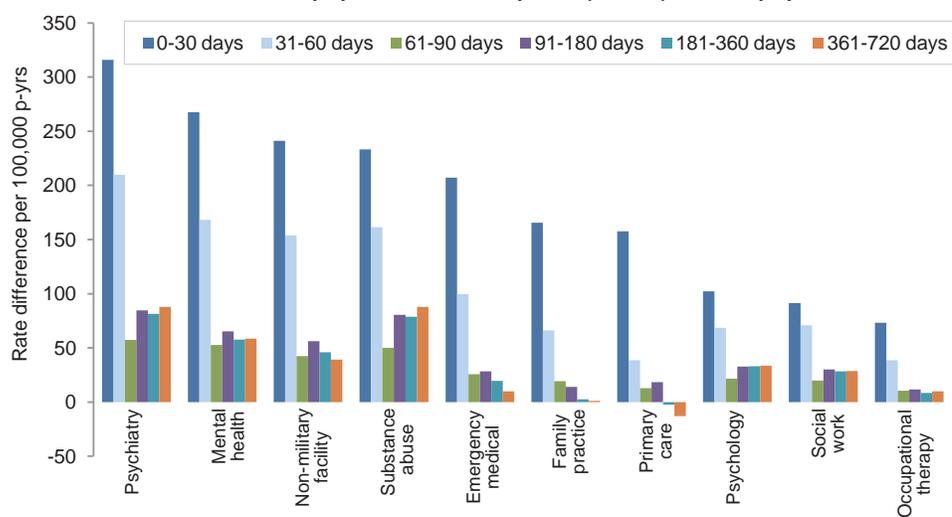
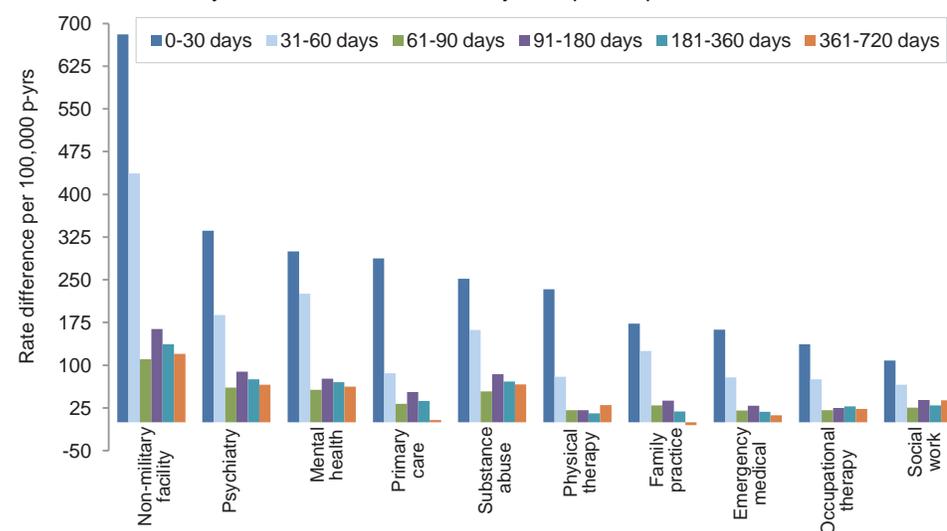


FIGURE 2C. Rate difference (“excess incidence”) in outpatient clinic visits among service members with “likely self-harm” vs. referents, by time period prior to self-harm



combine diagnoses thought to be predictive of suicide (see article on page 7) and the results of this report to identify individuals that should be screened for suicide risk. Suicide risk screening for high-risk patients could help to identify patients that would benefit from additional care. Moreover, interventions that specifically target post-hospitalized patients such as “caring letters” may help to prevent suicide.^{12,13}

Author affiliations: National Center for Telehealth and Technology, Defense Center of Excellence (DCoE) for Psychological Health and Traumatic Brain Injury, Tacoma, Washington. (Ms Trofimovich, Drs Skopp, Luxton and Regier).

REFERENCES

1. Armed Forces Health Surveillance Center. Deaths while on active duty in the U.S. Armed Forces, 1990-2008. *MSMR*. 2009 May;16(5):2-5.
2. Kuehn BM. Soldier suicide rates continue to rise: military scientist work to stem the tide. *JAMA*. 2009 Mar 18;301(11):1111-1113.
3. Levin A. Dramatic increase found in soldier suicides. *Psychiatric News*. 2007 Sep;42(18):9.
4. Luoma JB, Martin CE, Pearson JL. Contact with mental health and primary care providers before suicide: a review of the evidence. *Am J Psychiatry*. 2002 Jun;159:909-916.
5. Gillmore JM, Chan CH. Suicide: a focus on primary care. *WMJ*. 2004;103(6):88-92.
6. Sudak S, Roy A, Sudak H, et al. Deficiencies in suicide training in primary care specialties: a survey of training directors. *Acad Psychiatry*. 2007 Sep-Oct;31:345-349.
7. Morrison KB, Laing L. Adults' use of health services in the year before death by suicide in Alberta. *Health Rep*. 2011 Sep;22(3):15-22.
8. Renaud J, Chagnon F, Balan B, et al. Psychiatric service utilization in completed suicides of a youth centres population. *BMC Psychiatry*. 2006 Aug 23;6:36.
9. Hill R, Perkins R, Wexler L. An analysis of hospital visits during the 12 months preceding suicide death in northern Alaska. *Alaska Med*. 2007 Jan-Mar;49(1):16-21.
10. Power K, Davies C, Swanson V, Gordon D, Carter H. Case-control study of GP attendance rates by suicide cases with or without a psychiatric history. *Br J Gen Pract*. 1997 Apr;47(417):211-5.
11. Patrick AR, Miller M, Barber CW, et al. Identification of hospitalizations for intentional self-harm when E-codes are incompletely recorded. *Pharmacoepidemiol Drug Saf*. 2010;19(12):1263-1275.
12. Luxton DD, June JD, Comtois KA. Can post-discharge follow-up contacts prevent suicide and suicide behavior?: a review of the evidence. *Crisis*. In press 2012.
13. Luxton DD, Kinn JT, June JD, et al. Caring Letters Project: A Military Suicide Prevention Pilot Program. *Crisis*. 2012 Jan; 33(1):5-12.

Relations between Suicide and Traumatic Brain Injury, Psychiatric Diagnoses, and Relationship Problems, Active Component, U.S. Armed Forces, 2001-2009

Nancy A. Skopp, PhD; Lily Trofimovich, MS; COL Jamie Grimes, MD; Lynne Oetjen-Gerdes, PhD; Gregory A. Gahm, PhD

This retrospective case-control study of members of the active component of the U.S. Armed Forces compared those who died from suicide to controls matched by service, gender, race, age, date of entry into the active component, and years of service. The surveillance period was 2001 to 2009. The groups were compared with respect to numbers of deployments and documented diagnoses of traumatic brain injury (TBI), mood disorders, alcohol dependence, post-traumatic stress disorder (PTSD), partner relationship problems, and family circumstance problems. Cases and controls were similar regarding frequencies and types of TBIs and numbers of deployments. In multivariate analyses, increased odds of suicide were associated with mood disorders, partner relationship problems, and family circumstance problems, but not with mild TBI, alcohol dependence, or PTSD. A separate analysis revealed that psychiatric comorbidities increased odds of suicide. Limitations are discussed, including the possibility that some controls with mild TBIs may have died from suicide after their military service.

Traumatic brain injury (TBI) and suicide are concerning issues to the U.S. military. A recent review of responses to a screening questionnaire documented that 10 percent to 20 percent of a cohort of soldiers redeploying from Operations Iraqi and Enduring Freedom (OIF/OEF) reported experiences consistent with TBIs.¹

Historically, military suicide rates have been lower than civilian rates. However, suicide rates among U.S. military members have increased recently and are now higher than rates among civilians with similar demographic characteristics.²

The Institute of Medicine (IOM) recently reviewed existing research on the potential association between TBI and suicide and noted that there is insufficient empirical evidence to determine whether such an association exists.³ A large study of TBI patients in Denmark revealed that, relative to the general population, suicide risk was elevated among TBI patients across the range of severity (standardized mortality ratios of 3.0, 2.7, and 4.1 for mild, moderate, and severe TBIs, respectively).⁴ However,

several smaller studies in non-military populations did not find increased suicide risk among patients diagnosed with TBI.^{5,6}

In a retrospective study of 22 psychiatric inpatients who were military veterans with histories of mild (n=1), moderate (n=11), and severe (n=10) TBIs, six had made suicide attempts.⁷ A study of military service veterans who received care through the Veterans Healthcare Administration (VHA) from 2001-2006 indicated that veterans with histories of TBIs were at increased risk for suicide.⁸ In sum, the extent to which TBI may increase suicide risk – in general or in military populations specifically – is unclear.

Studies in both non-military and military populations have noted associations between TBI, psychiatric diagnoses (including substance abuse), and suicide.⁹⁻¹³ A recent U.S. Army epidemiological study found that suicide attempters were more likely than suicide completers to have diagnosed psychiatric problems.¹⁴ Such findings suggest that suicide attempters and suicide completers may represent distinct, but overlapping, groups.¹⁵

Social adjustment in relation to TBI is another area of concern to the military. Of note in this regard, partner relationship problems appear to be associated with mild as well as severe TBIs;¹⁶⁻¹⁸ in addition, partner relationship problems may relate to suicidal behaviors.¹⁹⁻²⁰ In response to such concerns, the 2010 Army Health Promotion Risk Reduction Suicide Prevention Report recommended research to clarify the relation between partner relationship problems and suicide.²¹

Finally, some evidence suggests that suicide risk may remain elevated for years after a traumatic brain injury.^{12,22} Other research suggests that the risk period for suicide following TBI may be limited or non-existent.^{4,14}

In summary, there are limited empirical data regarding TBI in relation to suicide mortality. Despite the high numbers of reported TBIs associated with deployments to Afghanistan and Iraq and the increased rate of suicide among U.S. military members, relationships between TBI and suicide among active duty military members have not been rigorously examined. This report documents 1) the prevalence and severity of TBIs among U.S. service members with and without completed suicides, 2) the latencies between TBI (by severity) and suicide, and 3) whether TBI increases the odds of suicide mortality after controlling for psychiatric diagnoses and partner relationship problems.

METHODS

For this report, a retrospective case-control study was conducted using records routinely provided to the Armed Forces Health Surveillance Center (AFHSC) and maintained in the Defense Medical Surveillance System (DMSS).²³

The study population consisted of individuals who had served in the active component of the U.S. military between

January 1, 2001 and December 31, 2009. Suicide cases (n=1,764) were identified through the Department of Defense (DoD) Medical Mortality Registry maintained by the Office of the Armed Forces Medical Examiner and were included in these analyses if the death had been officially declared a suicide of a service member in the active component. Controls (n=7,018) were randomly selected and matched in a 4:1 ratio to cases by service, gender, race (white, black, other), age within one year, entry into active component service within one year, and within one year of total active duty military service.

Dates and countries of deployment were used to determine the number of deployments to OEF/OIF among cases and controls.

Psychiatric diagnoses and behavioral health problems: Psychiatric diagnoses and partner relationship and family circumstance problems were ascertained from ICD-9-CM coded diagnoses that were reported on standardized records of inpatient and outpatient encounters in “fixed” (e.g., not deployed, at sea) military medical facilities and civilian facilities (contracted/purchased care through the Military Health System). **Table 1** provides the ICD-9-CM codes for each psychiatric condition and behavioral health problem entered as covariates in the conditional logistic regression model. For purposes of these analyses, these variables were defined as dichotomous (i.e., the presence of one of the ICD-9-CM codes of interest in any diagnostic position qualified an individual as having the condition or problem of interest).

TBI: The DoD’s standard TBI surveillance case definition was used to ascertain TBI status and severity; in brief, this definition describes a TBI case as any TBI-related diagnosis in any diagnostic position during a single hospitalization or ambulatory visit in a U.S. military medical facility, or a civilian facility (i.e., MHS reimbursed care), or on a standardized record of an in-theater medical encounter of a deployed service member in the Theater Medical Data Store (TMDS). **Table 1** includes a list of ICD-9-CM diagnostic codes that are considered indicator diagnoses of TBI. If diagnoses

TABLE 1. ICD-9-CM grouping of diagnostic categories and V-codes

Diagnostic category	ICD-9 codes
Alcohol dependence	303
Mood disorders	296.0, 296.2-296.7, 296.80, 296.89, 296.90, 300.4, 301.13, 311
PTSD	309.81
Partner relationship problems	V61.0, V61.1
Family circumstance problems	V61.2, V61.23, V61.24, V61.25, V61.29, V61.8, V61.9
Traumatic brain injury (TBI)	310.2,800.xx, 801.xx, 803.xx, 804.xx, 850.xx-854.xx, 950.1x-950.3x, 959.01, V15.5_1-9, V15.59_A-V15.59_F
mild TBI (subset of all TBI codes)	310.2, 800.00-800.02, 800.06, 800.09, 800.50, 800.52, 801.00, 801.01, 801.02, 801.06, 801.09, 801.50, 801.51, 801.52, 803.00-803.02, 803.06, 803.09, 803.50, 803.51, 803.52, 804.00, 804.01, 804.02, 804.06, 804.09, 804.50, 804.51, 804.52, 850.0, 805.1, 850.11, 850.9, 959.01, V15.52, V15.5_7, V15.5_C, V15.52_2, V15.52_2,V15.52_7, V15.52_C

of two or more TBIs fell within 30 days of each other, they were considered one TBI for analysis purposes.

Statistical analyses: Chi-square tests of homogeneity were performed to determine if the proportions of TBIs by severity were significantly different among cases and controls. A binary logit model with the Newton-Raphson ridge optimization technique was used to conduct conditional logistic regression analysis of matched paired data to model the relation between suicide and TBI, psychiatric comorbidities, and partner relationship and family circumstance problems.²⁴ Because there were insufficient cases of moderate and severe TBI, the relation was modeled only for mild TBI cases. Prior to conducting the conditional logistic regression analysis, a power analysis using a Pearson Chi-square Test for two proportions was performed to ensure that there was adequate power to detect an odds ratio ≥ 1.5 . Results indicated that with the number of cases available, an odds ratio ≥ 1.3 with 80 percent power could be detected.

RESULTS

Ninety-six percent of the study subjects were males; 43.4 percent were Army, 20.1 percent were Air Force, 16.8 percent were Marine Corps, and 19.7 percent were Navy service members. Seventy-two

percent of the study subjects were younger than 25 years old; 11.8 percent were 25-29, 13.5 percent were 30-39, and 2.4 percent were 40 or older (**Table 2**).

Documented diagnoses of TBI

There were no statistically significant differences between suicide cases and matched controls regarding frequencies or

TABLE 2. Demographic and military characteristics of study suicide cases, active component, U.S. Armed Forces, 2001-2009

	Suicide	
	No.	%
Total	1,764	100
Service		
Army	766	43.4
Navy	348	19.7
Marine Corps	296	16.8
Air Force	354	20.1
Sex		
Male	1,696	96.1
Female	68	3.9
Age		
<25	1,275	72.3
25-29	209	11.8
30-39	238	13.5
40+	42	2.4

TABLE 3. TBI proportions by severity, gender, service, and age

TBI severity type (cases and controls) ^a						
	Severe	Moderate	Mild	Unclassified	None	Total
Cases	5 (0.3%)	25 (1.4%)	97 (5.5%)	2 (0.1%)	1,635 (92.7%)	1,764
Controls	11 (0.2%)	84 (1.2%)	323 (4.6%)	14 (0.2%)	6,586 (93.8%)	7,018
TBI severity type and gender (cases)						
	Severe	Moderate	Mild	Unclassified	None	Total
Male	5 (0.3%)	24 (1.4%)	91 (5.4%)	2 (0.1%)	1,574 (92.8%)	1,696
Female	0 (0%)	1 (1.5%)	6 (8.8%)	0 (0%)	61 (89.7%)	68
TBI by severity type and service (cases)						
	Severe	Moderate	Mild	Unclassified	None	Total
Army	1 (0.1%)	13 (1.7%)	52 (6.8%)	2 (0.3%)	698 (91.1%)	766
Navy	2 (0.6%)	5 (1.4%)	16 (4.6%)	0 (0%)	325 (93.4%)	348
Marine Corps	2 (0.7%)	3 (1.0%)	15 (5.1%)	0 (0%)	276 (93.2%)	296
Air Force	0 (0%)	4 (1.1%)	14 (4.0%)	0 (0%)	336 (95.0%)	354
TBI by severity type and age (cases)						
	Severe	Moderate	Mild	Unclassified	None	Total
<25	3 (0.2%)	14 (1.1%)	72 (5.7%)	2 (0.2%)	1,184 (92.9%)	1,275
25-29	1 (0.5%)	3 (1.4%)	15 (7.2%)	0 (0%)	190 (90.9%)	209
30-39	1 (0.4%)	7 (2.9%)	9 (3.8%)	0 (0%)	221 (92.9%)	238
40+	0 (0%)	1 (2.4%)	1 (2.4%)	0 (0%)	40 (95.2%)	42

^aCases, n=1,764; Controls, n=7,018

types of TBIs ($\chi^2=4.9$, p =not significant [ns]). Seven percent of cases and six percent of controls were diagnosed with TBIs. The distributions of TBIs among suicide cases according to TBI severity, gender, service, and age are presented in **Table 3**.

Time between TBI diagnoses and suicides

Time in days between traumatic brain injuries and suicides, by TBI severity, were: “mild” TBIs, $n=97$: mean=875 days, median=542 days; “moderate” TBIs, $n=25$: mean=1,122 days, median=682 days; and “severe” TBIs, $n=5$: mean=347 days, median=149 days. The times between TBIs and suicides across the TBI severity groups were not statistically significantly different ($F [2, 124]=1.46$, p = ns) (**data not shown**).

Associations with suicide mortality

There were not statistically significant differences in the number of deployments of cases (mean=1.3, $SD=.77$) and controls (mean=1.3, $SD=.80$), $F (1, 8,687)=.55$, p =.46; as such, the number of deployments was not controlled in subsequent analyses. During multivariate analyses that

TABLE 4. Conditional logistic regression predicting suicide mortality

Effect	Odds ratio (95% confidence interval)
Mild TBI	1.1 (0.88 – 1.42)
Mood disorder	1.6 (1.37 – 1.80)
Alcohol dependence	1.2 (0.92 – 1.45)
PTSD	1.1 (0.75 – 1.73)
Partner relationship problems	2.0 (1.51 – 2.63)
Family circumstance problems	2.0 (1.25 – 3.04)

accounted for the effects of mood disorders, alcohol dependence, PTSD, partner relationship problems, and mild TBI, mood disorders, partner relationship and family circumstance problems, but not mild TBI, were associated with increased odds of suicide mortality (**Table 4**).

TABLE 5. Number of psychiatric comorbidities and odds of suicide mortality

Effect	Odds ratio (95% confidence interval)
1 vs. No psychiatric diagnosis	1.5 (1.3 – 1.7)
2 vs. No psychiatric diagnosis	1.9 (1.4 – 2.6)
3 vs. No psychiatric diagnosis	6.4 (2.7 – 15.0)

In a separate analysis, psychiatric comorbidities were positively associated with increased odds of suicide mortality ($\chi^2=60.8$, $p <0.01$); this analysis documented a monotonic increase in the odds of suicide with increasing numbers of psychiatric comorbidities (**Table 5**).

EDITORIAL COMMENT

The analyses conducted for this report do not confirm that mild TBIs increase suicide risk in active component members of the U.S. military. The finding is contrary to that of the only large population-based study that has examined suicide risk in relation to TBI across all levels of severity.⁴ The different findings regarding the relationship between mild TBI and suicide risk may reflect important differences between the underlying populations and settings of the studies. For example, within civilian populations, TBIs, in general, appear to be associated with high risk behaviors (e.g., fighting, alcohol abuse) and psychopathology.²⁵⁻²⁷ However, within military populations, TBIs may more commonly be associated with injuries that occur during training exercises or exposures to combat. This distinction may have meaningful implications. Among civilians, an association between mild TBI and suicide might be attributable to pre-existing personality characteristics and psychopathology that increase or mediate suicide risk. Conversely, mild TBI among service members may more often be attributable to unpredictable events associated with military training and combat. It is currently believed that mild TBI typically resolves within a few months; if so, absent pre-existing risk factors for suicide, mild TBI would not be expected to increase suicide risk as much among affected military members as civilians.

It is possible that some of the mild TBI cases considered in this analysis died by suicide after they left military service. Although the majority of mild TBIs typically resolve within a matter of months with proper treatment, it is estimated that up to 20 percent of such cases do not improve.²⁸⁻²⁹ For individuals who do not improve, the persistence of their impairments may become more apparent over time. It is conceivable that such awareness in conjunction with other risk factors may increase suicide propensity, potentially accounting for longer latencies between mild TBIs and suicides – which, in some cases, may extend beyond the time of active military service.

This report assessed the experiences of actively serving military members; active service members are monitored medically and have ready access to resources that may be less accessible to military service veterans. In turn, suicide risk may increase after military members leave service. In light of the fact that most veterans do not seek care in the VHA, Brenner and colleagues suggested that veterans who receive care in the VHA may represent a particularly vulnerable group.⁸ Additional research is needed to clarify relationships between TBI and suicide risk in various military-associated groups (e.g., active duty, veterans seeking care in the VHA, veterans not seeking care in the VHA).

Our findings regarding psychiatric problems in relation to suicide have clinical implications. The finding of increasing suicide risk with increasing psychiatric comorbidities is particularly noteworthy; for example, service members with three psychiatric diagnoses had six-times higher suicide risk than service members without psychiatric diagnoses. The findings suggest the need for tailored interventions, highlight the importance of thorough assessments across multiple domains of symptomatology, and are consistent with The Army Health Promotion Risk Reduction Suicide Prevention Report's call for research to help determine the "order of operations" for treatment of comorbid conditions such as PTSD, TBI, and depression.²¹ Findings of this report also document that psychiatric problems increase risk

for suicide, even though suicide attempters may have higher levels of psychiatric diagnoses and comorbidities than suicide completers. Additional research is needed to characterize similarities and differences in the natures and severities of psychiatric problems among suicide attempters, suicide completers, and non-suicidal controls.

The finding that partner relationship problems increase risk of suicide is consistent with descriptive data obtained through retrospective examinations of characteristics of military suicide decedents.³⁰ The finding underscores the importance of clinical assessments of partner relationship functioning and suggests targets for intervention and preventive efforts. For example, it may be prudent for clinicians to assess service members' intimate relationship functioning, even when not the presenting problem, and to focus efforts on facilitating competent resolution of partner relationship problems where such problems exist. Efforts of this kind may potentially avert suicide crises associated with partner relationship dysfunction and dissolution.

There are limitations to the analyses presented here that should be considered when interpreting the results. For example, the accuracy of psychiatric diagnoses is unknown. However, the only alternate source of population level psychiatric data is the self-report screening data obtained from post-deployment screenings. Given the limitations of self-report screens versus the care with which military clinicians are likely to assign psychiatric diagnoses, together with our theoretically consistent psychiatric findings, the ICD-9-CM codes used for this research are likely to reflect reasonable estimates of psychiatric problems. In addition, for this analysis, there were insufficient numbers of moderate and severe TBI cases to determine whether more severe TBIs were associated with increased suicide risk. Also, this analysis did not examine functional and occupational impairments associated with mild TBIs, which may be more closely tied to suicide risk than TBI per se. Furthermore, a longer follow-up period might have provided additional information about mild TBI as a suicide risk factor.

As a final note, these findings might be interpreted to suggest that the majority of service members are resilient to adverse effects potentially associated with mild TBIs. In this regard, it should be noted that the analyses conducted for this report examined only one outcome; there are a range of other potential problematic outcomes that were not assessed. Caution is warranted in interpreting the findings beyond the limited scope of the analyses. Clearly additional research is needed to provide a more complete understanding of relations among TBI and suicide among active military members.

In summary, continuous wartime operations in Afghanistan and Iraq over the past decade have been associated with increases in mild TBIs and suicides among U.S. military members. The analyses conducted for this report do not provide evidence of increased suicide risk after mild TBI in US military members. The findings are informative and potentially useful; however, further research regarding the natures, clinical effects, and natural courses of TBIs of various severities and their associations, if any, with suicide risk are indicated.

Author affiliations: National Center for Telehealth and Technology, Defense Center of Excellence (DCoE) for Psychological Health and Traumatic Brain Injury, Tacoma, Washington (Ms Trofimovich, Drs Skopp, Gahm); University of Washington Medical School Department of Psychiatry and Behavioral Sciences (Dr Skopp, Gahm); Defense Veterans Brain Injury Center (DVBIC), Washington, DC (Dr Grimes); Armed Forces Medical Examiner System (AFMES), Dover Air Force Base, Delaware (Dr Oetjen-Gerdes).

REFERENCES

1. Army Surgeon General's Task Force on Traumatic Brain Injury, "Traumatic Brain Injury (TBI) Task Force Report Recommendation Summary." 17 January 2008. [http://www.armymedicine.army.mil/reports/tbi/TBI TaskForceReportJanuary2008.pdf](http://www.armymedicine.army.mil/reports/tbi/TBI%20TaskForceReportJanuary2008.pdf). Accessed 02/22/2010.
2. Kuehn BM. Soldier suicide rates continue to rise: military, scientists work to stem the tide. *JAMA*. 2009 Mar;301(11):1111-3.

3. Institute of Medicine. Committee on Gulf War and Health: Brain injury in veterans and long-term health outcomes board on population health and public health practice. Long-term Consequences of traumatic brain injury. 2008. Pre-publication copy.
4. Teasdale TW, Engberg AW. Suicide after traumatic brain injury: a population based study. *J Neurol Neurosurg Psychiatry*. 2001 Oct;71(4):436-40.
5. Lewin W, Marshall TF, Roberts AH. Long-term outcome after severe head injury. *Br Med J*. Dec 1979;77(6):1533-38.
6. Shavelle RM, Strauss D, Whyte J, et al. Long-term causes of death after traumatic brain injury. *Am J Phys Med Rehabil*. 2001 Jul;80(7):510-6.
7. Gutierrez PM, Brenner LA, Huggins JA. A preliminary investigation of suicidality in psychiatrically hospitalized veterans with traumatic brain injury. *Arch Suicide Res*. 2008;12(4):336-43.
8. Brenner LA, Ignacio RV, Blow FC. Suicide and traumatic brain injury among individuals seeking veterans health administration services. *J Head Trauma Rehabil*. 2011;26(4):257-64.
9. Rodgers JM, Read CA. Psychiatric comorbidity following traumatic brain injury. *Brain Inj*. 2007;2:1321-33.
10. Simpson G, Tate R. Clinical features of suicide attempts after traumatic brain injury. *J Nerv Ment Dis*. 2005 Oct;193(10):680-5.
11. Silver JM, Kramer R, Greenwald S, Weissman M. The association between head injuries and psychiatric disorders: findings from the New Haven NIMH. Epidemiologic Catchment Area Study. *Brain Inj*. 2001 Nov; 5(11):935-45.
12. Arsenault-Lapierre G, Kim K, Turecki G. Psychiatric diagnoses in 3,275 suicides: a meta-analysis. *BMC Psych*. Nov 2004;37(4).
13. Carlson KF, Nelson D, Orazem RJ, et al. Psychiatric diagnoses among Iraq and Afghanistan war veterans screened for deployment-related traumatic brain injury. *J Trauma Stress*. 2010 Feb;23(1):17-24.
14. Millikan A, Spiess A, Mitchell M, Fulcher S. The Behavioral and Social Health Outcomes Program. Analyses Army suicides, January 2005 -June 2010. US Army Public Health Command (Provisional), Epidemiological Report No. 14-HK-0DS8-10n.
15. DeJong TM, Overholser JC, Stockmeier CA. Apples to oranges? A direct comparison between suicide attempters and suicide completers. *J Affect Dis*. 2009 Nov.124:90-7.
16. Gosling J, Oddy, M. Rearranged marriages: Marriages after head injury. *Brain Inj*. 1999 Oct;13(10):785-96.
17. Wood R, Yurdakul, LK. Change in relationship status following traumatic brain injury. *Brain Inj*. 1997 Jul;11(7):491-502.
18. Landau J, Hissett, J. Mild traumatic injury: Impact on identity and ambiguous loss in the family. *Fam Sys and Health*. 2008 Mar.26(1):69-85.
19. Kaplan MS, McFarland BH, Huguet N. Characteristics of adult male and female firearm suicide decedents: Findings from the National Violent Death Reporting System. *Inj Prev*. 2009 Oct;15(5):322-7.
20. Magne-Ingvar U, Ojehagen A. One year follow up of significant others of suicide attempters. *Soc Psychiatry Psychiatr Epidemiol*. 1999 Sep;34(9):470-6.
21. Army Health Promotion Risk Reduction Suicide Prevention Report. 2010. http://www.armyg1.army.mil/hr/suicide/docs/Commanders%20Tool%20Kit/HPRRSP_Report_2010_v00.pdf. Accessed 02/22/2010.
22. Simpson G, Tate R. Suicidality after traumatic brain injury: demographic, injury and clinical correlates. *Psychol Med*. 2002 May;32(4):687-97.
23. Rubertone MV, Brundage JF. The Defense Medical Surveillance System and the Department of Defense Serum Repository: glimpses of the future of comprehensive public health surveillance. *Am J Pub Hlth*. 2002 Dec;92(12):1900-4.
24. Jennrich RI, Robinson SM. A Newton-Raphson algorithm for maximum likelihood factor analysis. *Psychometrika*. 1969;34(1):111-23.
25. Kim E. Agitation, aggression, and disinhibition syndromes after traumatic brain injury. *NeuroRehabilitation*. 2002;17(4):297-310.
26. Bjork JM, Grant SJ. Does traumatic brain injury increase risk for substance abuse? *J Neurotrauma*. 2009 Jul;26(7):1077-82.
27. Simpston G, Tate R. Suicidality in people surviving a traumatic brain injury: prevalence, risk factors and implications for clinical management. *Brain Inj*. 2007 Dec;21(13-14):1335-51.
28. Kennedy JE, Jaffee MS, Leskin GA, et al. Posttraumatic stress disorder and posttraumatic stress disorder-like symptoms and mild traumatic brain injury. *J Rehabil Res Dev*. 2007;44(7):895-920.
29. Vasterling JJ, Verfaellie M, Sullivan KD. Mild traumatic brain injury and posttraumatic stress disorder in returning veterans: Perspectives from cognitive neuroscience. *Clin Psychol Rev*. 2009 Dec;29(8):674-84.
30. Logan J, Skopp N, Karch D, et al. (in press). Characteristics of suicides among active duty US Army military personnel: 17 US states, 2005-2007. *Am J Public Health*.

Outpatient Encounters Associated with Diagnostic Codes for Migraine and Other Types of Headaches, Active Component Service Members, 1998-2010

This analysis examines incidence rates, prevalences, and outpatient encounters for migraine and other headache syndromes among active component members of the U.S. Armed Forces from 1998 through 2010. For both migraine and other headache syndromes, incidence rates, prevalences, and rates of outpatient encounters increased during the period. In 2010, 3.9 percent of male service members and 11.3 percent of females had at least one outpatient encounter for an episode of headache; rates were higher among females than males. Among service members ever diagnosed with migraine, 3 percent of men and 6 percent of women had more than 10 encounters for migraine; for other headache syndromes, the respective percentages were less than 1 percent. The introduction of new ICD-9 codes during the period had little effect on the coding practices for migraine, but did modestly affect the coding practices for other headache syndromes.

Migraine is a common disorder marked by episodes of moderate to severe headache (typically unilateral in adults); episodes are often accompanied by other symptoms such as nausea and vomiting, photophobia, and sensitivity to movement. Migraine headaches may be preceded by disturbances of perception (aura) involving the senses of vision, hearing, or smell. Attacks of migraine are often severe and may recur frequently enough that they interfere with activities of daily living; as such, migraines can significantly degrade the military operational effectiveness of affected service members.

It has been estimated that, among adults in the United States, migraine affects as many as 18 percent of women and 6 percent of men during their lifetimes.¹ A previous *MSMR* report showed that 25.6 percent of all outpatient health care visits for diagnoses categorized as “neurological disorders” in the military health care system from 1998-2010 were associated with diagnoses of migraine in the primary (first listed) diagnostic position of the health record.² However, studies have shown that most persons whose headache symptoms fit the clinical case definition of migraine have never been diagnosed with migraine

by a physician and have used only over-the-counter pain medications to treat their symptoms.¹ The incidence and prevalence of migraine among women are estimated to be 3 to 5 times higher than among men.

Non-migraine headaches are also common. Most adults experience at least occasional headaches and have learned both to recognize them and to self-treat without seeking help from a health care provider. Following the introduction of a new set of 24 ICD-9-CM codes (339.xx) for “other headache syndromes” (under the category of “neurological disorders”) in late 2008, 8.7 percent of all military health care system outpatient encounters for “neurological disorders” in 2010 were associated with diagnoses of “other headache syndromes.”²

This analysis examines the incidence, prevalence, and health care burden of outpatient care of active duty service members associated with diagnoses of migraine and other headache syndromes.

METHODS

The surveillance period encompassed the 13 years from January 1, 1998 through December 31, 2010. The surveillance population included all members of the active

component of the U.S. Armed Forces who served any time during the surveillance period. Outcomes of interest were outpatient encounters for which “migraine” or “other headache syndromes” (i.e., non-migraine headaches) were recorded as primary (first-listed) diagnoses on standardized records of care (hospitalizations were not examined). Outpatient encounters of interest were identified from records maintained in the Defense Medical Surveillance System, an administrative database that includes records of medical encounters of members of the U.S. Armed Forces in military and civilian (reimbursed care) treatment facilities.

Migraine diagnoses were defined as conditions documented with any of the forty-two 3-, 4-, and 5-digit diagnostic codes included in ICD-9-CM disease category 346 “migraine.” Diagnoses of other headache syndromes (hereafter referred to as “other headaches”) were defined as conditions documented with any of the twenty-eight 3-, 4-, and 5-digit ICD-9-CM diagnostic codes that specify headache disorders not classified under “migraine.” These include 307.80 (psychogenic pain, site unspecified), 307.81 (tension headache), 310.2 (postconcussion syndrome), 784.0 (headache), and the twenty-four codes (339.00 – 339.89) for “other headache syndromes” introduced into the ICD-9-CM system in late 2008.

Incident cases of migraine were defined as individuals with at least one outpatient encounter for which a migraine-specific ICD-9-CM diagnostic code was recorded as the primary (first-listed) diagnosis. The incidence date was the date of the first such encounter. Individuals who had received a diagnosis of migraine prior to the surveillance period were included. For incidence rate estimates, each affected individual was counted as an incident case of migraine only once during the surveillance period. For purposes of estimating period prevalences of and total outpatient encounters (“health care burden”) associated with migraine, all migraine-specific

outpatient encounters were included. Denominators for the calculation of incidence rates and outpatient encounters of migraine were based on total person-years (p-yrs) of service in the active component minus p-yrs during deployment. For period prevalence rates, the denominator was the number of active component service members on active duty at the beginning of each year.

All service members who had at least one outpatient encounter for migraine were considered "migraine patients." Migraine patients were excluded from estimates of incidence and prevalence of "other headaches."

Incident cases of "other headaches" were defined as individuals who were not migraine patients (per definition above) and had at least one outpatient encounter for which any one of the ICD-9-CM codes indicative of "other headaches" was the primary (first-listed) diagnosis. The incidence date was the date of the first such encounter. Individuals who had received a diagnosis of "other headaches" or migraine prior to the surveillance period were included. For incidence rate estimates, each affected individual was counted as an incident case only once during the surveillance period. For purposes of estimating period prevalences of and outpatient care ("health care burden") associated with "other headaches," all such outpatient encounters were included. Denominators for the calculation of rates of "other headaches" were calculated like those for migraine.

In a separate analysis of the relationship between migraine and "other headaches," the health records of all "migraine patients" were examined to determine the frequencies of encounters for "other headaches" before and after incident diagnoses of migraine.

RESULTS

Migraine

During the 13-year surveillance period, there were 514,192 outpatient encounters of active component members with "migraine" as the primary (first-listed) diagnosis (Table 1). The annual number of such encounters rose 127

percent from 1998 (24,609 visits) through 2010 (55,786 visits). Over the entire period, the increase in numbers of annual encounters for migraine was steady except for slight decreases in 2005 and 2006 (Figure 1); of note, however, annual rates of incident diagnoses fell from 1998 (107.9 incident cases per 10,000 p-yrs) through 2001 (91.0 cases per 10,000 p-yrs) and then increased modestly through 2010 (129.4 cases per 10,000 p-yrs). The rate in 2010 was 42 percent higher than the lowest annual incidence rate (2001) of the period (Figure 1).

The overall incidence rate of migraine was more than three times higher among females (332.8 cases per 10,000 p-yrs) than males (73.4 cases per 10,000 p-yrs). Among females, age-group-specific incidence rates

sharply declined with increasing age. Similarly, among males, the lowest incidence rate affected the oldest age group (>44 years); in contrast to females, however, among males, rates were fairly similar across age groups other than the oldest (Table 1).

In general, period prevalences of migraine by year (the number of individuals with at least one migraine encounter during each calendar year per 10,000 population) increased during the surveillance period. For example, among both males and females, period prevalences were markedly higher in 2010 than in 1998 (period prevalences, 1998 versus 2010: males, 66.7 versus 123.4 per 10,000; change, +84.9%; females, 345.9 versus 600.5 per 10,000; change, +73.6%) (Figure 2).

TABLE 1. Numbers and rates of encounters and incident cases of migraine and "other headaches" by gender, age, and service, active component, U.S. Armed Forces, 1998-2010

		Migraine		"Other headache" diagnoses	
No. of encounters 1998-2010		No.	Rate	No.	Rate
Males	All ages	259,451	180.7	444,378	325.8
	17-24	82,651	146.8	197,542	364.3
	25-34	99,491	192.3	151,709	311.5
	35-44	66,934	219.1	81,644	284.5
	>44	10,375	207.4	13,483	283.3
Females	All ages	254,741	1,016.4	153,264	758.2
	17-24	94,471	846.5	84,260	898.0
	25-34	102,311	1,135.0	46,570	664.0
	35-44	49,620	1,199.9	18,759	584.5
	>44	8,339	1,105.8	3,675	604.1
Incident cases 1998-2010		No.	Rate	No.	Rate
Males	All ages	103,055	73.4	258,719	194.3
	17-24	40,350	72.5	126,739	236.5
	25-34	37,210	73.9	81,744	172.8
	35-44	22,061	74.8	43,190	156.2
	>44	3,434	70.9	7,046	153.2
Females	All ages	75,363	332.8	92,270	518.5
	17-24	36,849	350.0	54,915	627.6
	25-34	26,114	330.2	25,849	437.5
	35-44	10,676	300.0	9,770	371.1
	>44	1,724	265.5	1,736	344.6
Males	All services	103,055	73.4	258,719	194.3
	Army	41,315	89.6	113,782	262.5
	Air Force	26,722	78.8	56,506	177.4
	Coast Guard	2,314	53.8	5,648	137.2
	Marine Corps	10,461	53.1	30,893	162.2
	Navy	22,243	61.2	51,890	149.2
Females	All services	75,363	332.8	92,270	518.5
	Army	28,216	369.0	38,975	653.3
	Air Force	25,366	340.1	26,774	474.4
	Coast Guard	1,267	242.7	1,433	329.1
	Marine Corps	3,036	236.9	5,114	458.7
	Navy	17,478	304.8	19,974	431.0

In addition, rates of total migraine-related outpatient encounters markedly increased during the period. For example, among both males and females, rates of total outpatient encounters for migraine more than doubled from 1998 to 2010 (annual rates of outpatient encounters for migraine, 1998 - 2010: males: 106.5 - 276.1 per 10,000 p-yrs; females, 600.0 - 1,366.6 per 10,000 p-yrs) (Figure 2).

Among the Services, the highest overall incidence rates were among members of the Army and Air Force; and between these Services, among both males and females, overall incidence rates were higher among Army than Air Force members (Table 1). Of note, however, the differences in incidence rates between Army and Air Force members – both males and females – markedly increased after 2004. As a result, for example, incidence rates were higher among women in the Army than those in the Air Force by 8.5 percent overall but 34.9 percent in calendar year 2010; similarly, incidence rates were higher among men in the Army than those in the Air Force by 13.7 percent overall but 80.5 percent in 2010 (data not shown).

Among the 103,058 men who ever received a diagnosis of migraine, 59,215 (57.5%) had only one migraine-specific outpatient encounter. The overall average number of migraine encounters among affected men was 2.5; however, approximately 3 percent (n=3,050) of all affected

TABLE 2. Numbers of encounters for “migraine” and “other headaches,” by gender, active component, U.S. Armed Forces, 1998-2010

	Migraine patients' migraine encounters			Encounters for patients with only "other headaches"		
	No. of persons	Cumulative percentage of all encounters	No. of encounters	No. of persons	Cumulative percentage of all encounters	
Males	59,215	22.8	1	182,481	41.1	
	40,793	77.8	2 - 10	73,992	90.5	
	2,283	90.1	11 - 20	1,684	95.8	
	471	94.5	21 - 30	338	97.6	
	296	100.0	Over 30	227	100.0	
Females	34,813	13.7	1	61,405	40.1	
	36,176	67.6	2 - 10	30,548	96.6	
	3,268	85.7	11 - 20	265	98.9	
	681	92.2	21 - 30	34	99.4	
	429	100.0	Over 30	20	100.0	

men had more than 10 encounters each for migraine (Table 2). Among the 75,367 women who ever received a diagnosis of migraine, 34,813 (46.2%) had only one migraine-specific outpatient encounter. The overall average number of migraine encounters among affected women was 3.4; however, approximately 6 percent (n=4,378) of all affected women had more than 10 outpatient encounters each for migraine (Table 2).

“Migraine unspecified” (ICD-9-CM code: 346.9) was reported as the diagnosis for nearly two-thirds (62.3%) of the 514,192 outpatient encounters in which

migraine was the primary diagnosis. Diagnoses of “migraine without aura” (ICD-9-CM code: 346.1) and “migraine with aura” (ICD-9-CM code: 346.0) accounted for an additional 17.0 percent and 12.2 percent, respectively, of all migraine-specific outpatient encounters. Of interest, the 30 migraine-specific ICD-9-CM codes added to the category of “migraine” (ICD-9-CM code: 346) in 2008 accounted for only 0.5 percent of all migraine diagnoses during the 13 year surveillance period and only 2.7 percent of all migraine diagnoses in calendar year 2010 (data not shown).

“Other headaches”

During the surveillance period, there were 597,642 outpatient encounters with primary diagnoses of “other headaches” among active component service members who had never been diagnosed with “migraine.” The annual number of such encounters declined by 13 percent from 1998 (n=39,024) through 2005 (n=33,877) and then sharply increased through 2010 (n=75,643); as such, the number of encounters in 2010 was 123 percent higher than in 2005 (Figure 3).

There was a similar trend of decreasing and then sharply rising rates of incident diagnoses of non-migraine headaches during the period. Annual incidence rates declined from 1998 (233.4 incident cases per 10,000 p-yrs) through 2005 (194.0

FIGURE 1. Incidence rates of migraine clinic encounters by gender and numbers of migraine encounters, active component, U.S. Armed Forces, 1998-2010

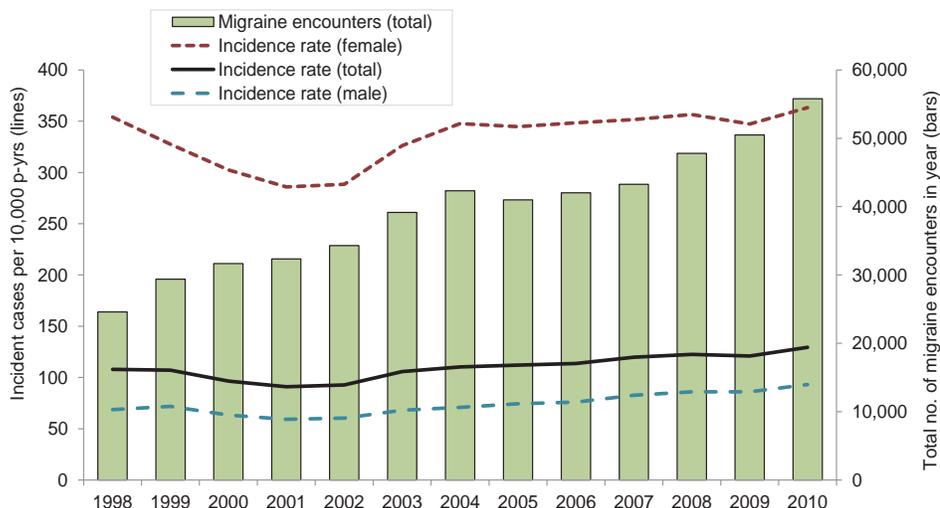
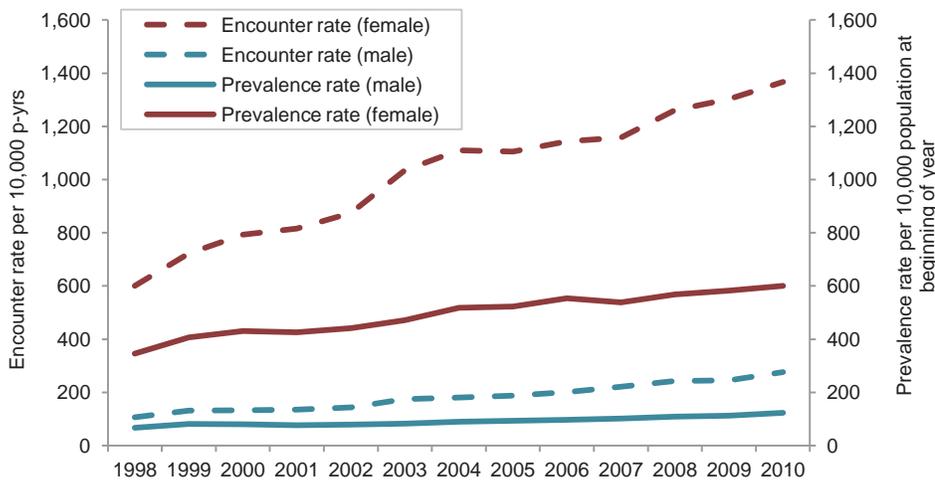


FIGURE 2. Annual prevalence rates and rates of encounters for “migraine,” by gender, active component, U.S. Armed Forces, 1998-2010.



cases per 10,000 p-yrs) and then increased steadily through 2010 (302.4 cases per 10,000 p-yrs); as such, the rate in 2010 was 56 percent higher than in 2005 (Figure 3).

The overall incidence rate of “other headaches” was much higher among females (518.5 cases per 10,000 p-yrs) than males (194.3 cases per 10,000 p-yrs). Among both males and females, incidence rates declined with increasing age (Table 1).

Estimated period prevalences (total persons with at least one “other headache” encounter per 10,000 population per year) decreased from 1998 through 2005 and then increased steadily through 2010. As such, period prevalences were 78.5 percent and 52.7 percent higher among males and females, respectively, in 2010 than 2005 (data not shown). Similarly, rates of all outpatient encounters for “other headaches” (per 10,000 p-yrs) rose from 1998 through 2010 among both males (231.7 in 1998 to 569.6 in 2010) and females (740.9 in 1998 to 1,041.5 in 2010) (data not shown).

Among the Services, the highest overall incidence rates of non-migraine headache diagnoses were among Army and Air Force members (Table 1). Among members of these services, overall incidence rates were much higher among both female (37.7%) and male (29.3%) Army than Air Force members (data not shown).

Of the 258,719 men who were diagnosed with a non-migraine (“other”) headache and never a migraine, 182,481

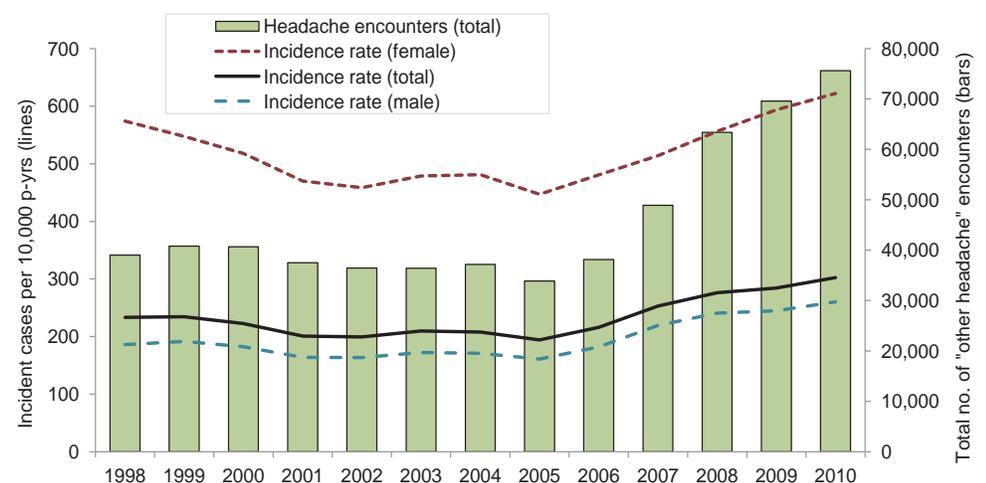
(70.5%) had only one non-migraine headache-related outpatient encounter during the period. Among men diagnosed with “other headaches” (but not migraine), the average number of “other headache”-specific encounters was 1.7; fewer than 1 percent (n=2,249) had more than 10 “other headache”-specific encounters (Table 2). Of the 92,270 women who were diagnosed with a non-migraine (“other”) headache and never a migraine, 61,405 (66.5%) had only one “other headache”-specific outpatient encounter during the period. Among women diagnosed with “other headaches” (but not migraine), the average number of encounters for “other headaches” was

1.7; fewer than 1 percent (n=319) had had more than 10 “other headache”-specific encounters (Table 2).

“Headache” (ICD-9-CM code: 784.0) was reported as the diagnosis for approximately three-fourths (73.3%) of the 597,642 encounters with “other” (non-migraine) headache-related diagnoses as primary diagnoses. Diagnoses of “postconcussion syndrome” (ICD-9-CM code: 310.2), “tension headache” (ICD-9-CM code: 307.81) and “other headache syndromes” (ICD-9-CM code: 339.89) accounted for an additional 10.2 percent, 8.9 percent, and 4.7 percent, respectively, of all “other headache”-specific encounters (data not shown).

In 2008, 24 diagnostic codes were added to the ICD-9-CM category of “other headaches” (ICD-9-CM code: 339). These new codes accounted for 6.9 percent of all “other headache”-specific diagnoses during the entire surveillance period but 29.0 percent of all such encounters in calendar year 2010; “other headache syndromes” (ICD-9-CM code: 339.89) accounted for more than two-thirds (68%) of all uses of the new “other headache”-specific codes in 2010 (data not shown). Other new codes that have been relatively frequently used since 2008 specify post-traumatic headache (ICD-9-CM code: 339.20-339.22) (15% of new code use) and tension headache (ICD-9-CM codes: 339.10-339.12) (11% of new code use).

FIGURE 3. Incidence numbers and rates of “other headache” clinic encounters, by gender, active component, U.S. Armed Forces, 1998-2010.



“Other headaches” among migraine patients

Of all men and women identified as “migraine patients” during the surveillance period, 62 percent (n=63,894) and 57 percent (n=42,918), respectively, had no encounters for “other headaches” prior to their first diagnoses of migraine. Similarly, after their incident diagnoses of migraine, 63 percent (n=64,974) of men and 56 percent (n=42,138) of women had no subsequent diagnoses of “other headaches” (Table 3). Although most migraine patients were not diagnosed with “other headaches” before or after their migraine diagnoses, migraine patients did account for 372,976 outpatient encounters for “other headaches” during the surveillance period.

Outpatient health care burdens for headache syndromes (migraine plus “other headaches”)

During the period, “migraine patients” accounted for 514,192 migraine-specific and 372,976 “other headache”-related outpatient encounters. In addition, service members who were never diagnosed with migraine accounted for 597,642 outpatient encounters for “other headaches.” During the entire period, migraine and other headaches accounted for 1,484,810 outpatient encounters; and during calendar year 2010 alone, migraine and “other headaches” accounted for 160,916 outpatient encounters. In 2010, headache syndromes accounted for approximately 8 of every 1,000 outpatient encounters of U.S. service members in the U.S. Military Health System.

EDITORIAL COMMENT

This analysis documented increasing rates of incidence, annual prevalence, and annual numbers of outpatient encounters for migraine among U.S. military members during the period 1998-2010. Rates among females were 3- to 4-times higher than among males. Appreciable numbers of service members (more than 3,000 males and 4,000 females) had more than ten outpatient encounters associated with primary diagnoses of migraine during the period. The most frequently recorded migraine

TABLE 3. Numbers of encounters for “other headaches” among migraine patients before and after their initial diagnosis of migraine, by gender, active component, U.S. Armed Forces, 2011

	Before 1st migraine			After 1st migraine		
	No. of persons	Cumulative percentage of all encounters	No. of “other headaches” encounters	No. of persons	Cumulative percentage of all encounters	
Males	63,894		0	64,974		
	19,903	21.7	1	17,508	15.0	
	18,603	88.0	2 - 10	18,915	73.2	
	659	100.0	Over 10	1,657	100.0	
Females	42,918		0	42,138		
	16,723	24.5	1	14,692	15.3	
	15,504	95.3	2 - 10	17,442	80.1	
	218	100.0	Over 10	1,097	100.0	

diagnoses were “migraine unspecified” (ICD-9-CM code: 346.9), “migraine without aura” (ICD-9-CM code: 346.1) and “migraine with aura” (ICD-9-CM code: 346.0), together accounting for 91.5 percent of all migraine diagnoses. The addition of 30 new ICD-9-CM codes to the category of “migraine” (ICD-9-CM code: 346) in 2008 had little apparent impact on the increasing frequency of migraine diagnoses.

For “other headaches” there were also overall increases in the rates of incidence, annual prevalence, and annual numbers of outpatient encounters during the surveillance period. Female rates were over twice as high as those among males. Repeated “other headaches” encounters were not as common as was the case with migraine, but there were still over 2,000 males and over 300 females who had more than ten encounters for “other headaches” during the surveillance period. The introduction in 2008 of 24 new ICD-9-CM codes for “other headaches” resulted in subsequent changes in the relative proportions of the most frequently recorded diagnostic codes. The relatively non-specific diagnoses of “headache” (ICD-9-CM code: 784.0, an older code) and of “other headache syndromes” (ICD-9-CM code: 339.89, a new code) predominated and accounted for 75 percent of “other headaches” recorded in 2010. A pattern of increasing use of new codes for “post-traumatic headache” and “tension headache” were accompanied by drops in the frequency of use of the older codes for “post-concussion syndrome” and “tension headache.”

In light of published estimates of prevalences of migraine in the U.S. general population, the results of this study suggest a significant underestimate of the incidence and prevalence of migraine in U.S. military members. For example, period prevalence estimates of migraine in this study are not estimates of lifetime prevalence but rather of prevalence during military service. Also, this study relied upon diagnoses recorded during outpatient encounters. Clinicians may be reluctant to record a specific diagnosis of migraine in the absence of a patient history that satisfies the consensus clinical case definition. Even among patients in this study who were diagnosed with migraine, more than half of them had only one visit in which that diagnosis was recorded. If patients with mild forms of migraine are not initially diagnosed with migraine but obtain satisfactory relief from their symptoms and do not return for follow-up care, then the specific diagnosis of migraine may not be documented. The literature indicates that most patients with migraine are never given “migraine” diagnoses by a physician; if so, it is likely that the same shortfall in case ascertainment applies to the military health care system.^{1,3}

This study showed that it was common for eventual “migraine patients” to have numerous visits for “other headaches” before their first migraine encounters. It is likely that a methodical, case-finding survey of service members would disclose many migraine patients – perhaps a majority – for whom that specific diagnosis does not appear in their health care records.

Factors that result in underestimates of the incidence and prevalence of migraine among military members may similarly affect estimates of the incidence and prevalence of “other headaches.”

In 2010, 1.2 percent of active component male service members and 6.0 percent of females had outpatient encounters for migraine; an additional 2.7 percent of males and 5.3 percent of females had encounters for “other headaches.” Together, these data document that 3.9 percent of male service members and 11.3 percent of female service members had at least one outpatient encounter for an episode of headache (migraine or “other headaches”) in 2010. These proportions for 2010 are the highest since the beginning of the surveillance period in 1998.

The ratio of the migraine incidence rate among females to the rate among males during the entire surveillance period was 4.5, a figure consistent with the published literature. However, that ratio steadily declined from 2004 (ratio of 4.9) through 2010, when the ratio of 3.9 was the lowest in the entire period. A similar trend was apparent for the female to male ratio of annual prevalence rates (2004 ratio 5.7; 2010 ratio 4.9). The changes in these

female to male ratios were taking place during a period when both incidence and prevalence rates of migraine were steadily rising among both females and males. Previous studies have found associations between the incidence of migraine and other headache symptoms and deployment to southwest Asia. Factors that appeared to be associated with increased incidence of migraine or other headache disorders included deployment itself as well as diagnoses of concussion, anxiety disorder (including post-traumatic stress disorder), and depression.^{4,5,6} It is also worth noting that the post-deployment screening of service members for mild traumatic brain injury has become more thorough and systematic in recent years. It is plausible that enhanced scrutiny of service members following their return from the combat zones of southwest Asia has resulted in the identification and health care follow-up of increasing numbers of service members who might otherwise not have been diagnosed with specific headache syndromes such as migraine and “other headaches.”

Lastly, this analysis demonstrates that almost one percent of all outpatient care in the military health care system result in primary diagnoses of headache syndrome.

Moreover, about 4 percent of all service members had at least one outpatient encounter for a headache syndrome in 2010. The burdens of health care and lost duty time associated with headache are substantial.

REFERENCES

1. Kolodner K, et al. Pharmacy and medical claims data identified migraine sufferers with high specificity but modest sensitivity. *J Clin Epi.* 2004;57:962-972.
2. Armed Forces Health Surveillance Center. Relationships between increasing outpatient encounters for neurological disorders and introductions of associated diagnostic codes, active duty military service members, 1998-2010. *MSSMR.* 2011;(18): 2-8.
3. Goadsby PJ, et al. Migraine-current understanding and treatment. *NEJM.* 2002;346: 257-270.
4. Armed Forces Health Surveillance Center. Risk factors for migraine after OEF/OIF deployment, active component, U.S. Armed Forces. *Medical Surveillance Monthly Report (MSSMR).* 2009;(16):10-14.
5. Jankosky CD, et al. Headache disorders in the millennium cohort: epidemiology and relations with combat deployment. *Headache.* 2011;51: 1098-1111.
6. Hoge CW, et al. Mild traumatic brain injury in U.S. soldiers Returning from Iraq. *NEJM.* 2008;358:453-463.

Medical Evacuations from Operation Iraqi Freedom/Operation New Dawn, Active and Reserve Components, U.S. Armed Forces, 2003-2011

From January 2003 to December 2011, over 50,000 service members were medically evacuated from the Operation Iraqi Freedom (OIF)/Operation New Dawn (OND) theater of combat operations to a medical treatment facility outside of theater. During the period, the numbers and underlying causes of medical evacuations sharply varied in relation to the numbers of deployed service members and the natures of ongoing military operations. There were nearly five times as many medical evacuations for disease and non-battle injuries than for battle-related conditions. The majority of medical evacuations (87%) occurred among males; the major causes of medical evacuations differed among male and female deployers. Based on these findings, force health protection policies and practices should be tailored to the characteristics of the deployed force and the nature of the military operation.

From March 2003 to December 2011, over 2 million U.S. service members deployed one or more times in support of military operations in southwest Asia. In Iraq, Operations Iraqi Freedom (OIF) and New Dawn (OND) occurred sequentially – from 19 March 2003 through 31 August 2010 and 1 September 2010 through 31 December 2011, respectively.

In wartime theaters of operations such as Iraq, most medical care is provided by deployed military medical personnel; however, some injuries and illnesses require medical management outside the operational theater. In such cases, affected individuals are usually transported by air to a fixed military medical facility in Europe or the United States. At the fixed facility, they receive the specialized, technically advanced, and/or prolonged diagnostic, therapeutic, and rehabilitation care required.

Medical air transports (“medical evacuations”) are costly and generally indicative of serious medical conditions. Some serious medical conditions are directly related to participation in or support of combat operations (e.g., battle wounds); many others are unrelated to combat and may be preventable. The objectives of this report are to compare the natures, numbers, and

trends of conditions for which male and female military members were medically evacuated from the OIF/OND theater during the entire campaign.

METHODS

The surveillance period was 1 January 2003 to 31 December 2011. The surveillance population included all members of the active and reserve components of the U.S. Army, Navy, Air Force, Marine Corps, and Coast Guard who were evacuated during the surveillance period from the OIF/OND theater of the U.S. Central Command (CENTCOM) area of responsibility (AOR) to a medical treatment facility outside the CENTCOM AOR. Evacuations were included in analyses if the affected service member had at least one inpatient or outpatient medical encounter in a permanent military medical facility in the U.S. or Europe within ten days after the evacuation date. Records of all medical evacuations conducted by the U.S. Transportation Command (TRANSCOM) are routinely provided for health surveillance purposes to the Armed Forces Health Surveillance Center (AFHSC) via the Office of the Assistant Secretary of Defense for Health Affairs.

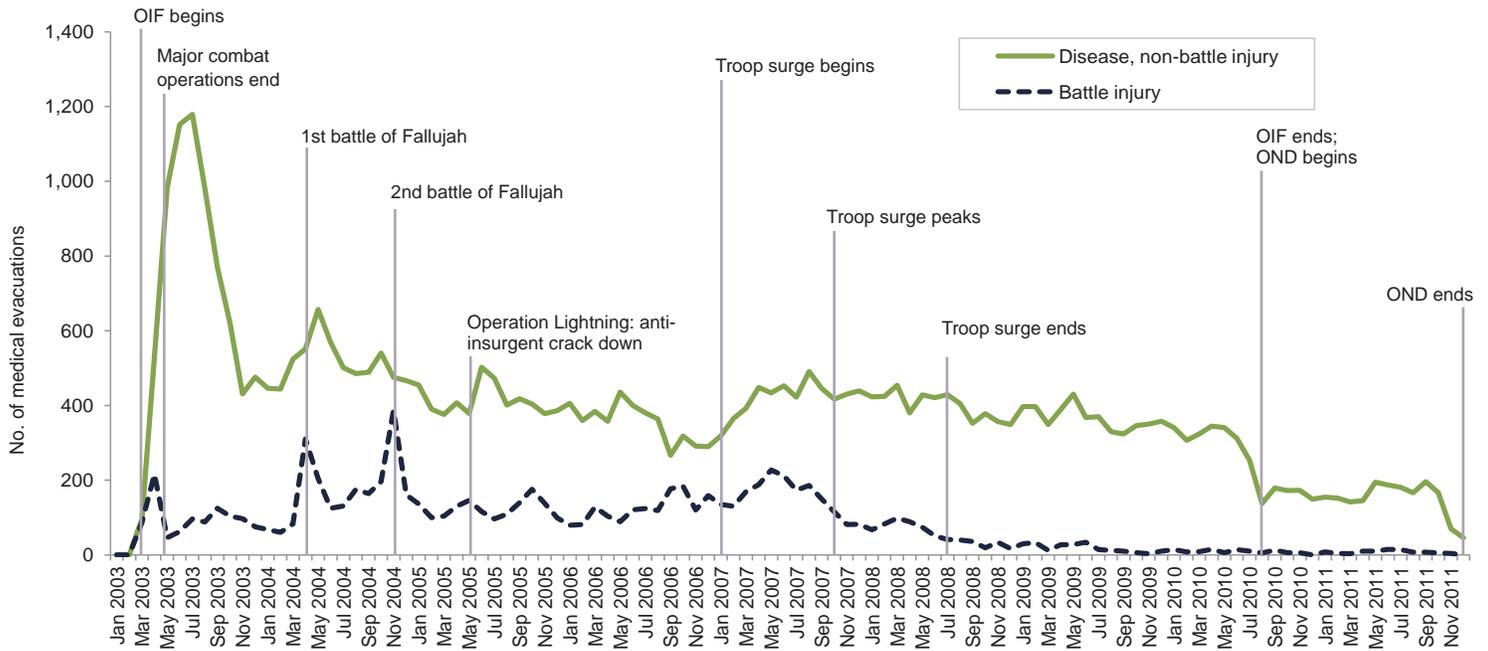
Medical evacuations included in the analyses were classified by the causes and natures of the precipitating medical conditions (based on information reported in relevant evacuation and medical encounter records). First, all medical conditions that resulted in evacuations were classified as “battle injuries” or “non-battle injuries and illnesses” (based on entries in an indicator field of the TRANSCOM evacuation record). Evacuations due to non-battle injuries and illnesses were sub-classified into 18 illness/injury categories based on International Classification of Diseases (ICD-9-CM) diagnostic codes reported on records of medical encounters after evacuation. For this purpose, all records of hospitalizations and ambulatory visits from five days prior to ten days after the reported date of each medical evacuation were identified. In most cases, the primary (first-listed) diagnosis for either a hospitalization (if one occurred) or the earliest ambulatory visit after evacuation was considered indicative of the condition responsible for the evacuation. However, if the first-listed diagnostic code specified the external cause (rather than the nature) of an injury (ICD-9-CM E-code) or an encounter for something other than a current illness or injury (e.g., observation, medical examination, vaccination [V-code]), then secondary diagnoses that specified illnesses and injuries (ICD-9-CM 001-999) were considered the likely reasons for the subject evacuations.

RESULTS

During the nearly nine-year period of the OIF/OND campaign, 50,634 medical evacuations of service members from OIF/OND were followed by at least one medical encounter in a fixed medical facility outside the operational theater. Overall, nearly seven times more males (n=44,258) than females (n=6,376) were medically evacuated (Table 1).

Of all medical evacuations, 17.7 percent were considered battle injury-related

FIGURE 1. Medical evacuations of U.S. service members from OIF/OND, by month, January 2003- December 2011



(Table 1). Not surprisingly, the numbers of evacuations for battle injuries varied in relation to the number of deployed service members (e.g., during troop surges compared to other periods) and the natures, locations, and intensities of ongoing combat operations (Figure 1). For example,

there were spikes in battle-related evacuations from OIF/OND in April 2003, April 2004, and November 2004 and another rise in April-May 2007 (Figure 1).

During every month of the nine year period, there were more medical evacuations for disease and non-battle injuries than

for battle-related injuries; overall during the period, there were nearly five times as many medical evacuations for non-battle as for battle-related conditions (Table 1, Figure 1).

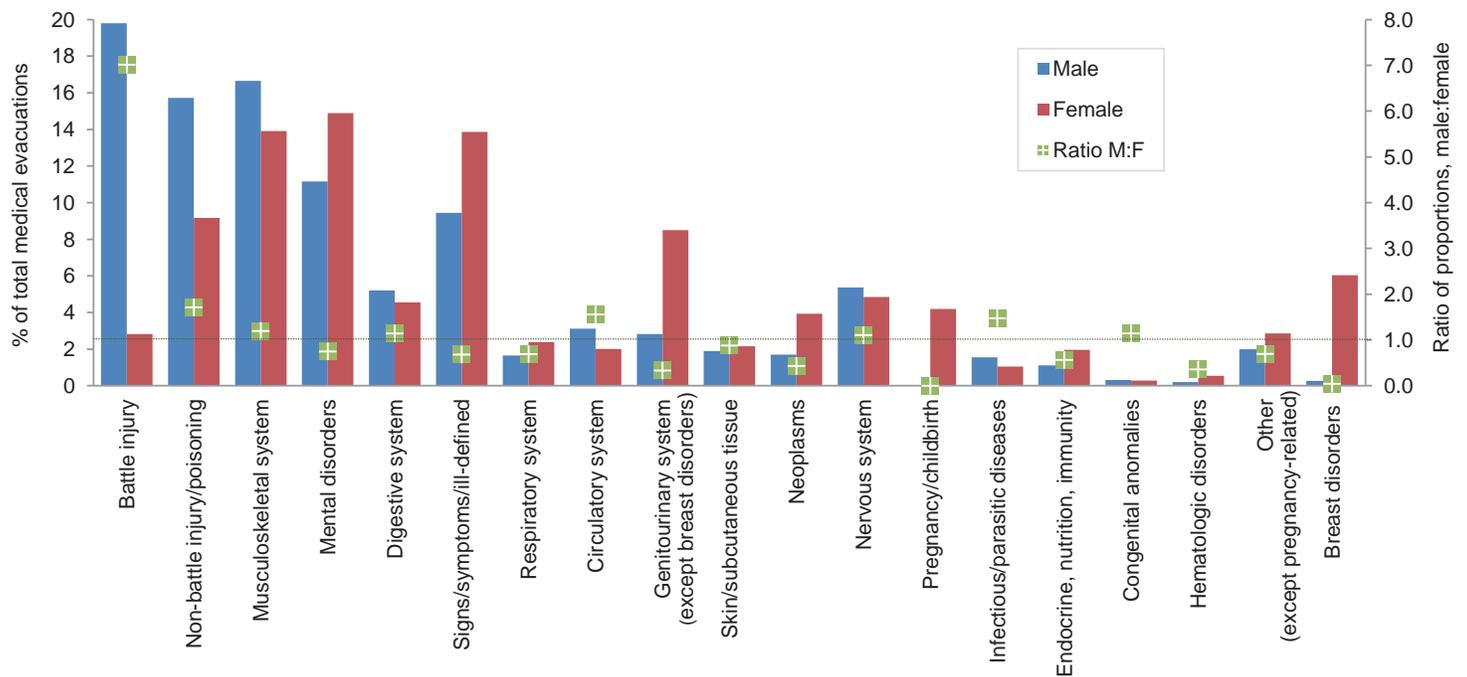
During the surveillance period, four categories of illnesses and non-battle injuries accounted for a majority (52.8%) of all evacuations. Musculoskeletal disorders, primarily affecting the back and knee, accounted for approximately one of every six (16.3%) evacuations; non-battle injuries, primarily sprains and fractures of extremities, accounted for approximately one of seven (14.9%) evacuations; mental disorders, most frequently adjustment reactions, mood disorders, anxiety disorders, and post-traumatic stress disorder (PTSD), accounted for approximately one of nine (11.6%) evacuations; and “signs, symptoms and ill-defined conditions” (more than one-fourth related to the respiratory system) accounted for one of ten (10.0%) evacuations (Table 1).

There were differences in the conditions that resulted in medical evacuations of male and female deployers. Of all medical evacuations of males throughout the period (n=44,258), the most frequent causes were battle injuries (19.8%), musculoskeletal disorders (16.7%), non-battle injuries (15.7%), and mental disorders (11.2%). In contrast, the most frequent

TABLE 1. Numbers and proportions of medical evacuations from OIF/OND by major categories of illnesses and injuries, January 2003-December 2011

Diagnostic category (ICD-9-CM)	Total		Total male		Total female	
	No.	%	No.	%	No.	%
Battle injury (from TRAC2ES records)	8,944	17.7	8,764	19.8	180	2.8
Musculoskeletal system (710-739)	8,257	16.3	7,370	16.7	887	13.9
Non-battle injury and poisoning (800-999)	7,542	14.9	6,957	15.7	585	9.2
Mental disorders (290-319)	5,892	11.6	4,942	11.2	950	14.9
Signs, symptoms, ill-defined conditions (780-799)	5,065	10.0	4,181	9.4	884	13.9
Nervous system (320-389)	2,684	5.3	2,375	5.4	309	4.8
Digestive system (520-579)	2,592	5.1	2,302	5.2	290	4.5
Genitourinary system (580-629, except breast)	1,794	3.5	1,252	2.8	542	8.5
Circulatory system (390-459)	1,512	3.0	1,384	3.1	128	2.0
Other (V01-V82, except pregnancy-related)	1,062	2.1	880	2.0	182	2.9
Neoplasms (140-239)	1,006	2.0	755	1.7	251	3.9
Skin and subcutaneous tissue (680-709)	980	1.9	842	1.9	138	2.2
Respiratory system (460-519)	882	1.7	730	1.6	152	2.4
Infectious and parasitic diseases (001-139)	753	1.5	686	1.6	67	1.1
Endocrine, nutrition, immunity (240-279)	616	1.2	491	1.1	125	2.0
Breast disorders (610-611)	502	1.0	117	0.3	385	6.0
Pregnancy and childbirth (630-679, relevant V codes)	268	0.5	0	0.0	268	4.2
Congenital anomalies (740-759)	161	0.3	143	0.3	18	0.3
Hematologic disorders (280-289)	122	0.2	87	0.2	35	0.5
Totals	50,634		44,258		6,376	

FIGURE 2. Proportions of medical evacuations, by major categories of illness/injury (ICD-9-CM), by gender, OIF/OND, U.S. Armed Forces, January 2003- December 2011



causes of medical evacuations of females during the period (n=6,376) were mental disorders (14.9%), musculoskeletal disorders (13.9%), “signs, symptoms, and ill-defined conditions” (13.9%), and non-battle injuries (9.2%) (Table 1, Figure 2).

Among both males and females, “adjustment reaction” was the most frequent specific diagnosis (3-digit diagnosis code of ICD-9-CM) during initial medical encounters after evacuations. “Adjustment reactions” accounted for relatively more of the total evacuations of females (n=370; 5.8%) than males (n=2,000; 4.5%). Among males, back and joint-related conditions – specifically, “intervertebral disc disorders” (n=1,609; 3.6%), “other and unspecified disorders of joint” (e.g., knee problems) (n=1,524; 3.4%), and “other and unspecified disorders of back” (n=1,196; 2.7%) – were the second, third, and fourth most frequent diagnoses among medical evacuees. The fifth most frequent diagnosis among males was “symptoms involving the respiratory system and other chest symptoms” (n=1,167; 2.6%) (data not shown).

Among females, “other disorders of the breast” (n=340, 5.3%), “other and unspecified disorders of joints” (e.g., knee problems) (n=236, 3.7%), “episodic mood disorders” (n=233, 3.7%), and “other

symptoms involving the abdomen and pelvis” (n=195, 3.1%) were the next most frequent diagnoses among medical evacuees (data not shown).

Among OIF/OND male participants, the proportion of medical evacuations attributable to battle injuries declined from approximately 29 percent in 2006 and 2007 to 5 percent in 2011 (Figure 3). In contrast, the proportion of medical evacuations attributable to mental disorders sharply increased from 7.1 percent in 2003 to 20.9 percent in 2010 then declined slightly to 17.6 percent in 2011 (Figure 3).

Among female participants, the proportion of medical evacuations attributable to battle injuries remained low compared to males with a peak at 5.5 percent in 2004 followed by a decrease to under 2 percent from 2008 to 2011 (Figure 4). The relative proportion of medical evacuations due to mental disorders among females increased sharply from 7.4 percent in 2003 to 26.6 percent in 2010 (Figure 4).

EDITORIAL COMMENT

A previous MSMR report estimated that during a 12-month deployment to combat operations in Iraq and Afghanistan,

approximately four percent of Army, two percent of Marine Corps, and one percent of the other services’ members were medically evacuated for any reason.¹ The relatively low likelihood of medical evacuation suggests that most deployers were sufficiently healthy and fit, and received the medical care in theater necessary, to successfully complete their OIF/OND assignments.

This analysis extends the findings of previous reports on medical evacuations from OIF/OND. It documents that the numbers and underlying causes of medical evacuations from OIF/OND sharply varied in relation to the numbers of deployed service members and the natures of ongoing military operations. The report also documents differences in the predominant causes of medical evacuations among male and female deployers.

The findings enforce the need to tailor force health protection policies, training, supplies, equipment, and practices based on characteristics of the deployed force (e.g., combat versus support; male versus female) and the nature of the military operations (e.g., combat versus humanitarian assistance).

There are limitations to the analysis reported here that should be considered

FIGURE 3. Proportions of medical evacuations for selected diagnostic categories among males, OIF/OND, U.S. Armed Forces, January 2003-December 2011

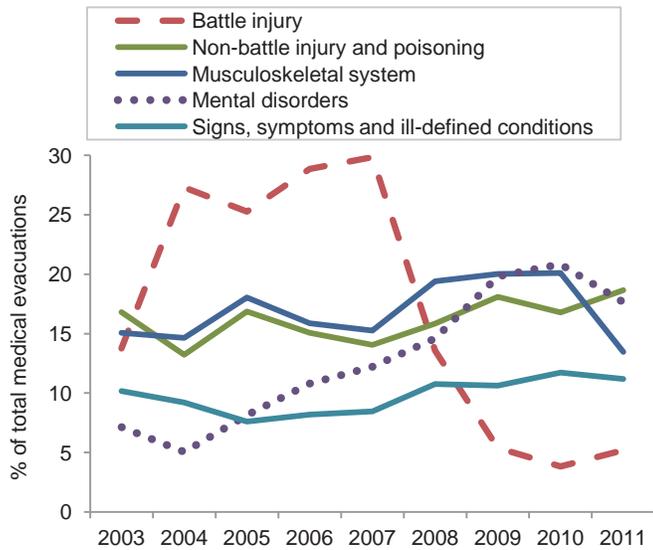
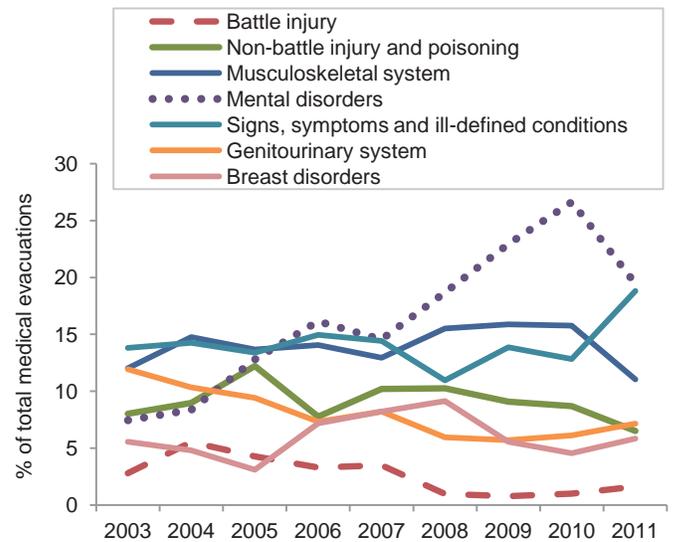


FIGURE 4. Proportions of medical evacuations for selected diagnostic categories among females, OIF/OND, U.S. Armed Forces, January 2003-December 2011



when interpreting the results. For example, assessments of trends were based on numbers of medical evacuations per month or year; as such, variations in the numbers of deployed troops (i.e., the population at risk of medical evacuation) over time were not factored in the analysis. Because the numbers of service members deployed to OIF/OND significantly varied during the period, trends of numbers of medical evacuations do not directly reflect changes in other risk factors for medical evacuation over time.

Also, direct comparisons of numbers and proportions of medical evacuations by cause, as between operational theaters or between males and females, can be misleading; for example, such comparisons do not account for differences between the groups in other characteristics (e.g., age, grade, military occupation, locations, and activities while deployed) that are significant determinants of medical evacuation risk. Also, for this report, most “causes” of medical evacuations were estimated from primary (first-listed) diagnoses that were recorded during hospitalizations or initial outpatient encounters after evacuation. In some cases, clinical evaluations in fixed medical treatment facilities after medical evacuations may have “ruled out” serious conditions that were clinically suspected in the theater. For this analysis, the “causes”

of such evacuations reflect diagnoses that were determined after evaluations outside of the theater rather than diagnoses – perhaps of severe disease – that were clinically suspected in the theater. To the extent that this occurred, the “causes” of some medical evacuations may seem surprisingly minor.

This report documents that, throughout OIF/OND (even during periods of the most intense combat), most medical evacuations were not directly related to battle injuries. Overall, approximately four of every five medical evacuations were due to illnesses and non-battle injuries; and of these, more than one-half were due to musculoskeletal disorders (16.3%), non-battle injuries (14.9%), mental disorders (11.6%), and “signs, symptoms, and ill-defined conditions” (10.0%).

In addition, this report documents that the proportions of medical evacuations due to mental disorders and battle injuries were not closely temporally related. For example, since 2007 among both male and female participants, the proportion of medical evacuations due to battle injuries sharply decreased while the proportion due to mental disorders increased (Figures 3, 4). The recent increase in mental disorder-related evacuations from Iraq may reflect, at least in part, increased awareness of, concern regarding, and health care resources dedicated to detecting and clinically

managing psychological, stress-related disorders (e.g., PTSD, depression, suicide ideation) among deployers.

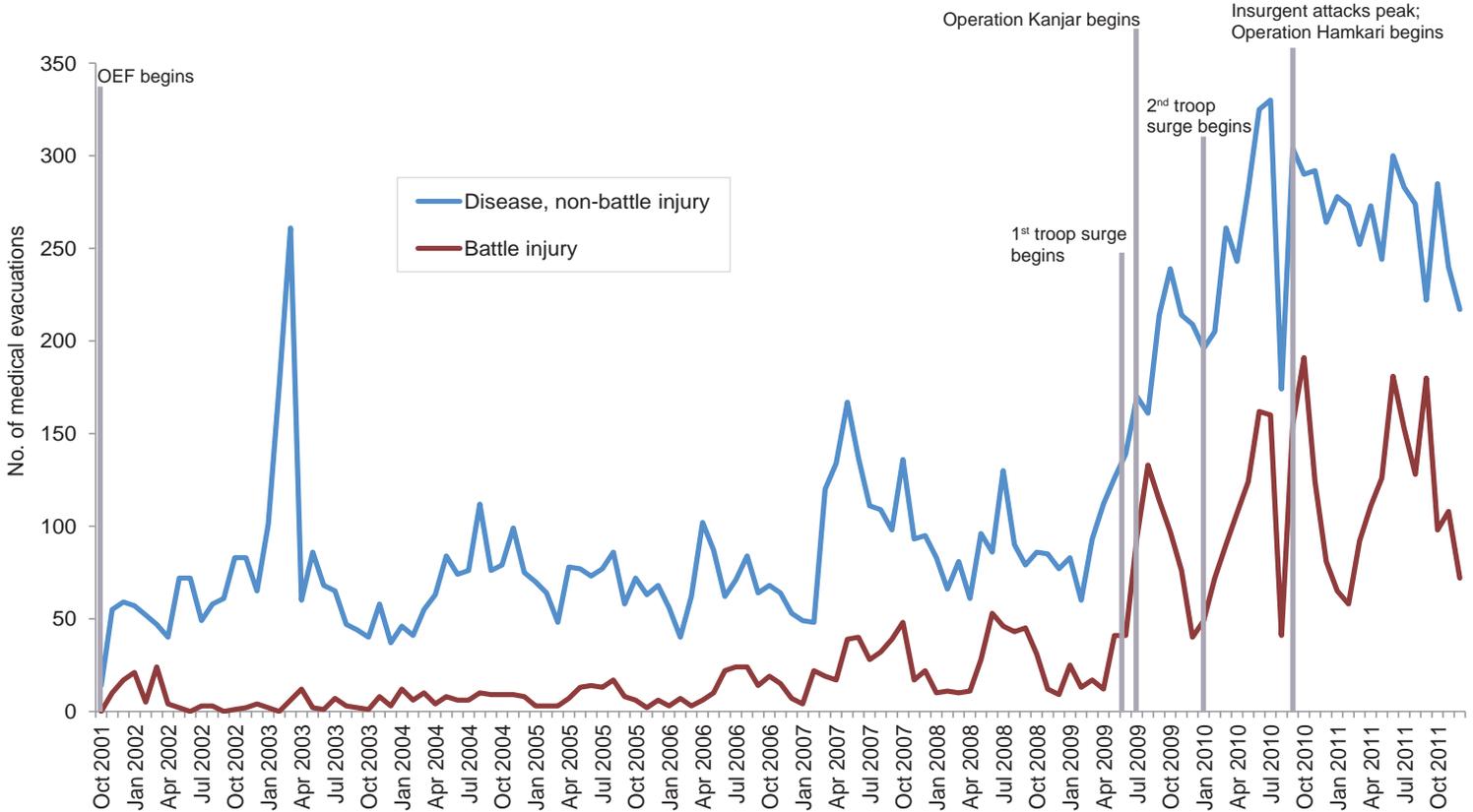
In summary, during the entirety of the campaign in Iraq, more than 50,000 U.S. service members were medically evacuated. Throughout the period, there were many more medical evacuations for illnesses and non-battle injuries than for battle injuries; also, the major causes of medical evacuations differed among male and female deployers. Previous reports have documented that relatively large proportions of service members who are evacuated for illnesses (including musculoskeletal and mental disorders) during deployments had medical encounters for the same or closely related conditions shortly before deploying.¹ Further analyses should identify conditions among male and female service members that are most likely to recur or worsen during, and require medical evacuation from, combat-related deployments.

REFERENCES

1. Armed Forces Health Surveillance Center. Medical evacuations from Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF), active and reserve components, U.S. Armed Forces, October 2001-September 2009. *Medical Surveillance Monthly Report (MSMR)*.17(2):2-7.

Surveillance Snapshot: Medical Evacuations from Operation Enduring Freedom (OEF), Active and Reserve Components, U.S. Armed Forces, October 2001-December 2011

Medical evacuations^a of U.S. service members from OEF (Afghanistan), by month, October 2001- December 2011

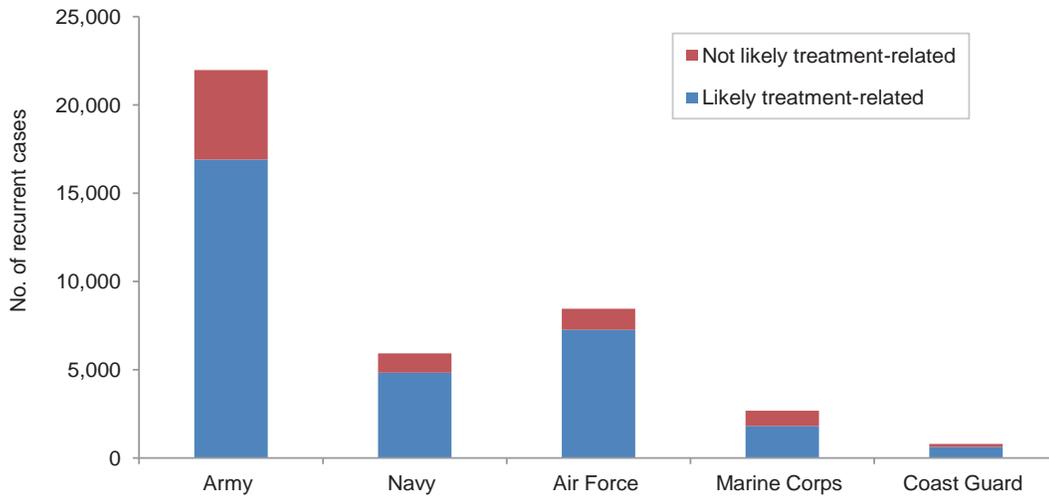


^aMethodology is the same as used for the medical evacuations from OIF/OND found on page 18.

From October 2001 to December 2011, there were 19,437 medical evacuations of service members from Operation Enduring Freedom (OEF) that were followed by at least one medical encounter in a fixed medical facility outside the operational theater. During every month of the period, there were more medical evacuations for conditions not directly related to battle than for battle-related injuries; overall, 23.4 percent of evacuations were considered battle injury-related. Total medical evacuations increased in 2009 following the surge in the number of service members deployed to Afghanistan. Since then, the numbers of evacuations per month have remained higher than pre-surge numbers, particularly in non-battle-related evacuations. Battle-injury evacuations tended to increase during the warmer months, presumably due to the impact of weather conditions on the natures, locations, and intensity of ongoing combat operations. For example, there were spikes in battle-related evacuations from OEF in August 2009, June through October 2010, and June through September 2011.

Surveillance Snapshot: Recurrent Medical Encounters Associated with Alcohol Abuse-related Diagnostic Codes, Active Component, U.S. Armed Forces, 2001-2010

Number of recurrent cases among service members diagnosed with acute alcohol abuse by treatment status, active component, U.S. Armed Forces, 2001-2010



In October of 2011, the *MSMR* published a 10-year summary of diagnoses related to alcohol abuse and dependence which demonstrated a gradual increase in both acute and chronic alcohol diagnoses over the past several years. In that report, approximately 21 percent of total incident acute alcohol diagnoses were considered “recurrent,” where a recurrent case was defined as “an individual with three or more acute encounters each separated by at least 30 days but occurring within one year of the first of the three diagnoses.”

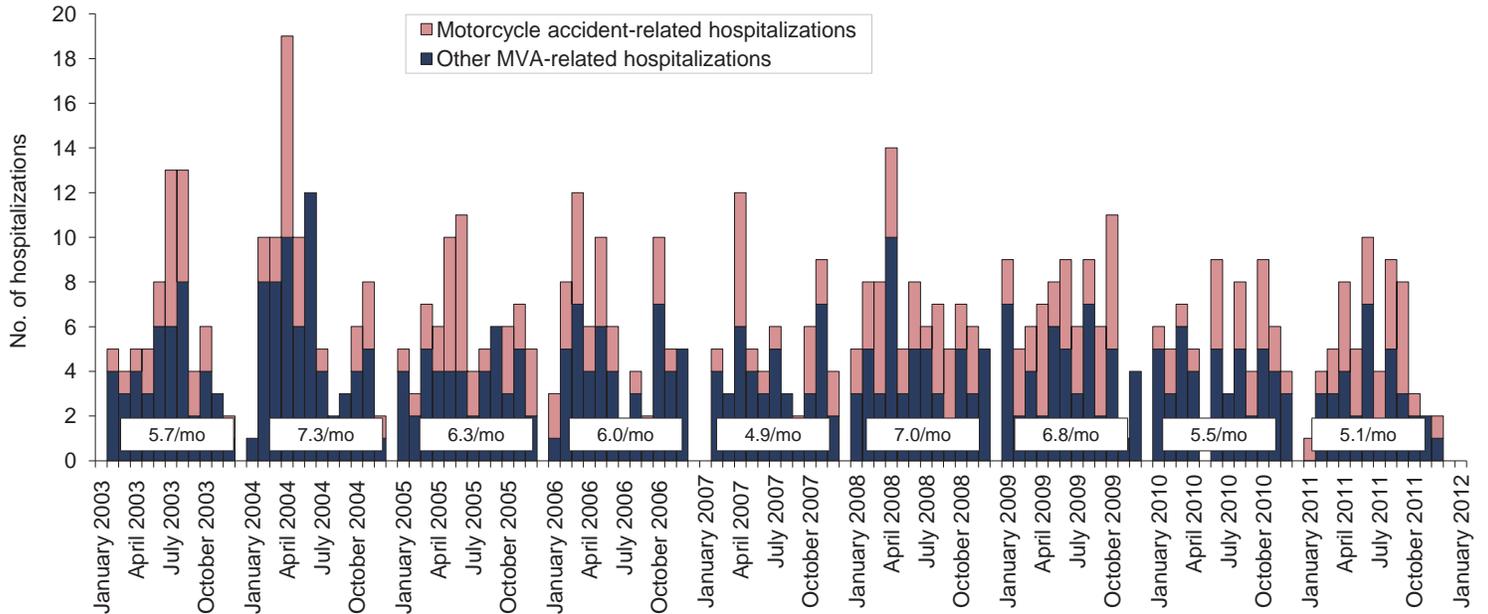
Following publication of that report, clinicians from the Air Force’s Alcohol and Drug Abuse Prevention and Treatment (ADAPT) expressed concern that the *MSMR*’s surveillance case definition for a recurrent alcohol diagnosis would misclassify an individual undergoing counseling or other treatment for alcohol abuse as a recurrent case. In the Air Force, assessment and treatment visits for alcohol abuse are coded using ICD-9-CM code 305.0 (“alcohol abuse”). An individual undergoing treatment for alcohol abuse may have multiple encounters with this diagnostic code within one year.

In response, the *MSMR* re-evaluated all active component service members classified as recurrent cases (n=38,919) using a new algorithm which assumed that recurrent cases with four or more encounters of alcohol abuse within a 42-day period were “likely treatment-related.” When this new algorithm was applied, 79 percent of cases previously classified as recurrent were “likely treatment-related” (chart). The recurrent cases not considered treatment-related represent approximately 4 percent of total incident acute alcohol diagnoses summarized in the October report.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - January 2012 (data as of 23 February 2012)

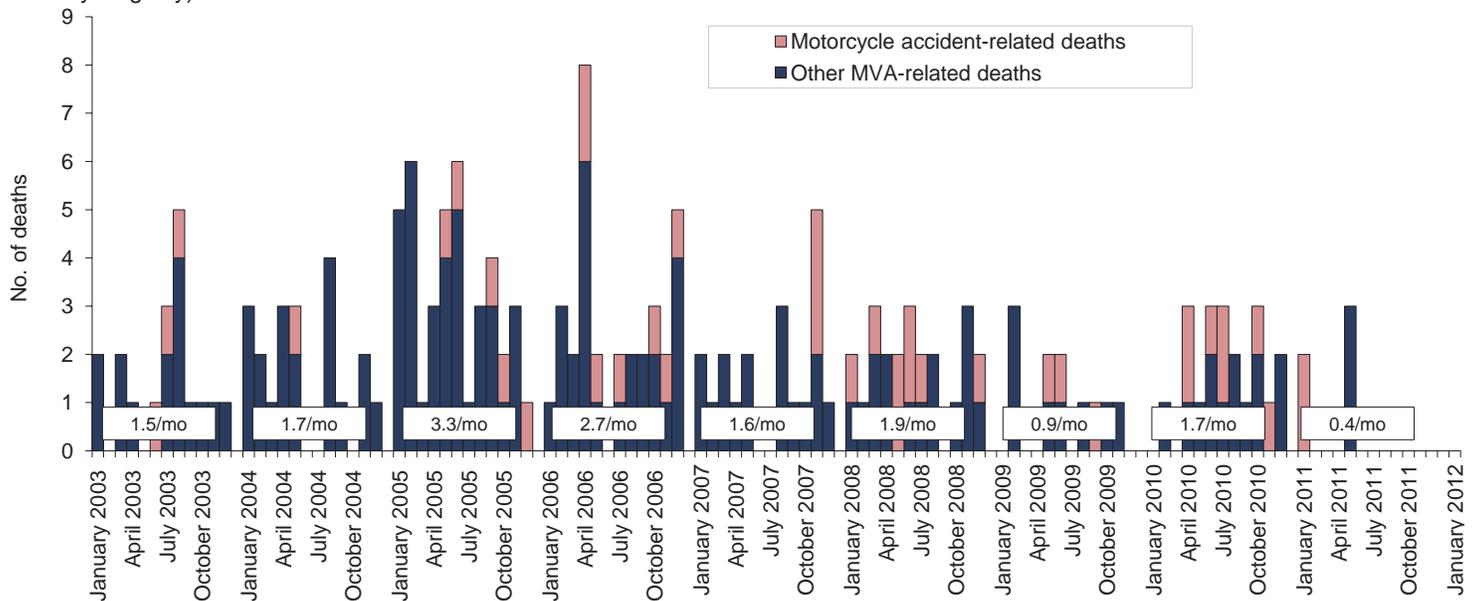
Note: The numbers of OEF/OIF/OND deployment-associated conditions in this report differ from those previously published in the *MSMR*. The change reflects an adjustment in the manner in which service members' deployments were associated with OEF/OIF/OND. The net effect is to decrease the numbers of service members with the conditions of interest who could be identified as having deployed to OEF/OIF/OND.

Hospitalizations for motor vehicle accidents occurring in non-military vehicles and outside of the operational theater (ICD-9-CM: E810-E825; NATO Standard Agreement 2050 (STANAG): 100-106, 107-109, 120-126, 127-129)



Note: Hospitalization (one per individual) while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days of another motor vehicle accident-related hospitalization.

Deaths following motor vehicle accidents occurring in non-military vehicles and outside of the operational theater (per the DoD Medical Mortality Registry)

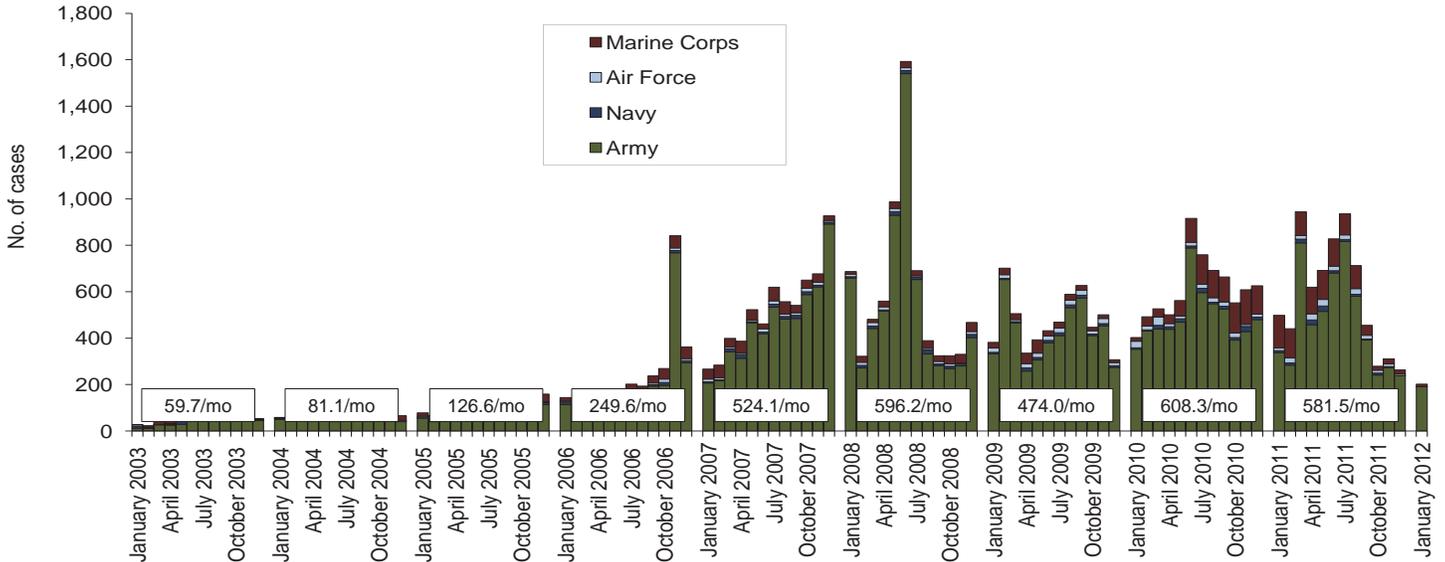


Reference: Armed Forces Health Surveillance Center. Motor vehicle-related deaths, U.S. Armed Forces, 2010. *Medical Surveillance Monthly Report (MSMR)*. Mar 11;17(3):2-6.
 Note: Death while deployed to/within 90 days of returning from OEF/OIF/OND. Excludes accidents involving military-owned/special use motor vehicles. Excludes individuals medically evacuated from CENTCOM and/or hospitalized in Landstuhl, Germany within 10 days prior to death.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - January 2011 (data as of 23 February 2012)

Note: The numbers of OEF/OIF/OND deployment-associated conditions in this report differ from those previously published in the *MSMR*. The change reflects an adjustment in the manner in which service members' deployments were associated with OEF/OIF/OND. The net effect is to decrease the numbers of service members with the conditions of interest who could be identified as having deployed to OEF/OIF/OND.

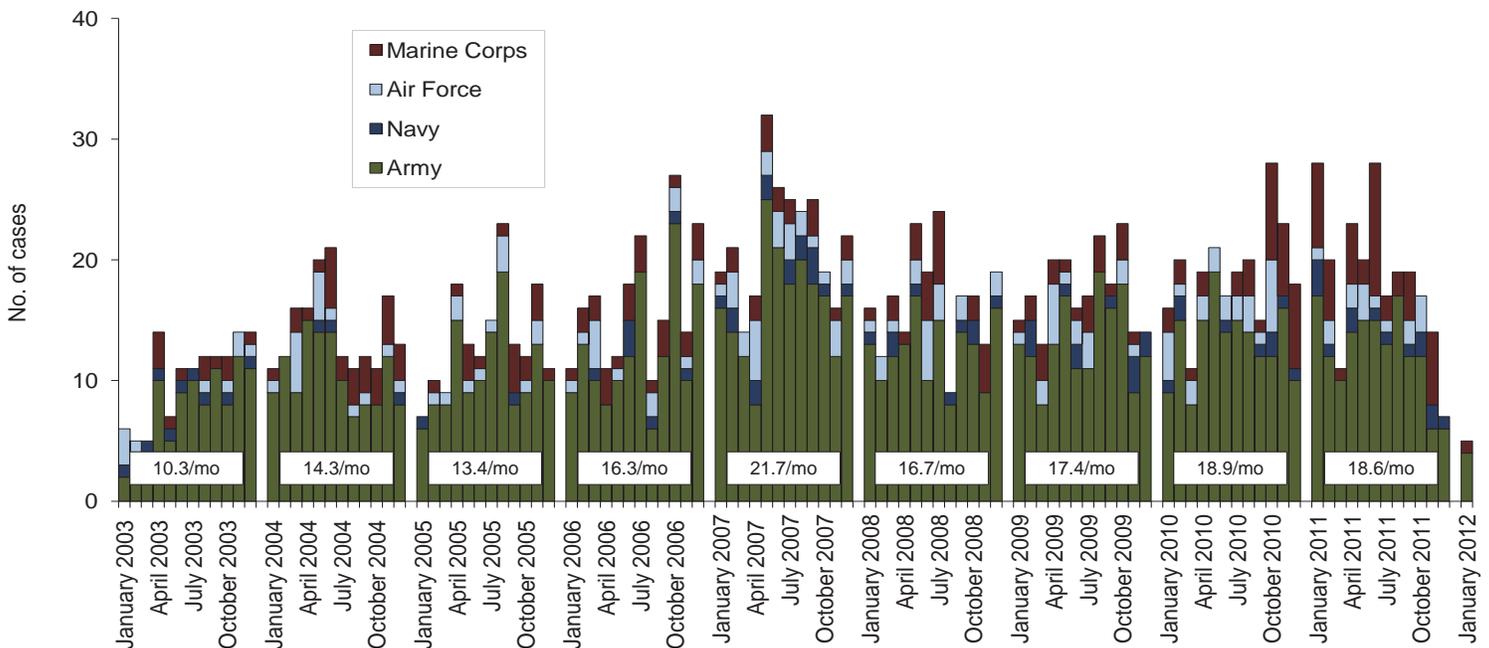
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.52_0-9, V15.52_A-F, V15.59_1-9, V15.59_A-F)^a



Reference: Armed Forces Health Surveillance Center. Deriving case counts from medical encounter data: considerations when interpreting health surveillance reports. *MSMR*. Dec 2009; 16(12):2-8.

^aIndicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from OEF/OIF/OND. (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 3,444 deployers who had at least one TBI-related medical encounter any time prior to OEF/OIF/OND).

Deep vein thrombophlebitis/pulmonary embolus (ICD-9: 415.1, 451.1, 451.81, 451.83, 451.89, 453.2, 453.40 - 453.42 and 453.8)^b



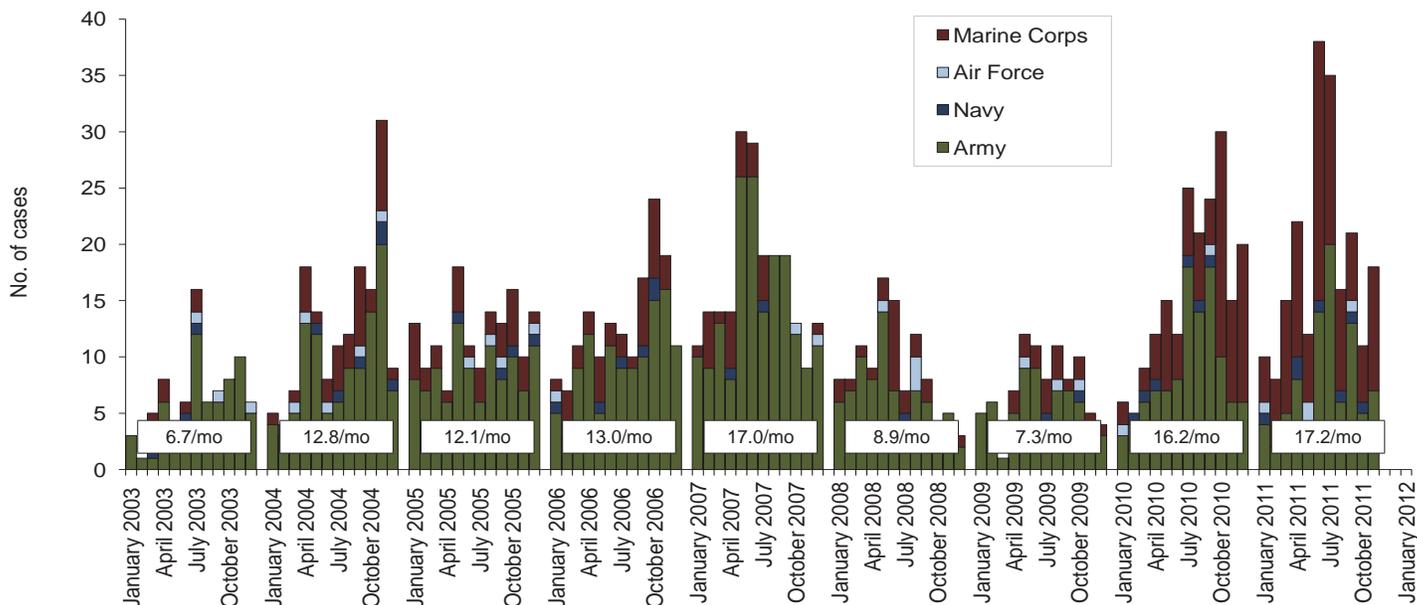
Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-83.

^bOne diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 90 days of returning from OEF/OIF/OND.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - January 2012 (data as of 23 February 2012)

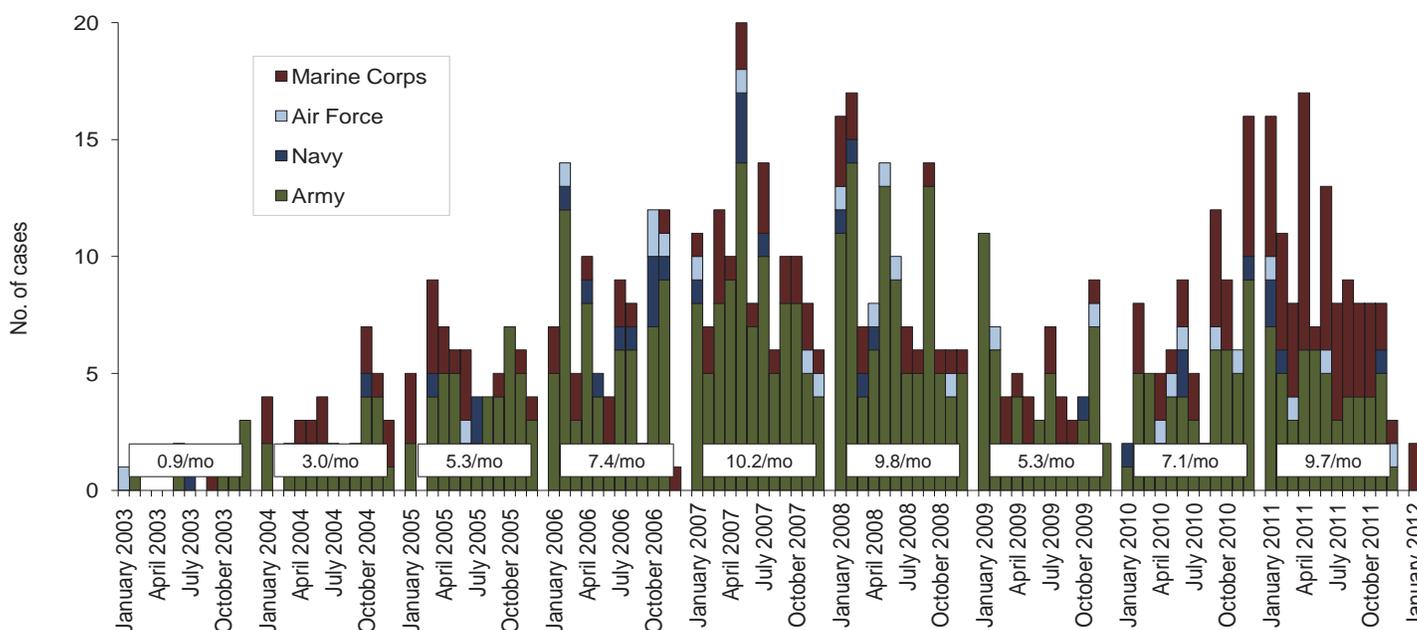
Note: The numbers of OEF/OIF/OND deployment-associated conditions in this report differ from those previously published in the *MSMR*. The change reflects an adjustment in the manner in which service members' deployments were associated with OEF/OIF/OND. The net effect is to decrease the numbers of service members with the conditions of interest who could be identified as having deployed to OEF/OIF/OND.

Amputations (ICD-9-CM: 887, 896, 897, V49.6 except V49.61-V49.62, V49.7 except V49.71-V49.72, PR 84.0-PR 84.1, except PR 84.01-PR 84.02 and PR 84.11)^a



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: amputations. Amputations of lower and upper extremities, U.S. Armed Forces, 1990-2004. *MSMR*. Jan 2005;11(1):2-6.
^aIndicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from OEF/OIF/OND.

Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)^b

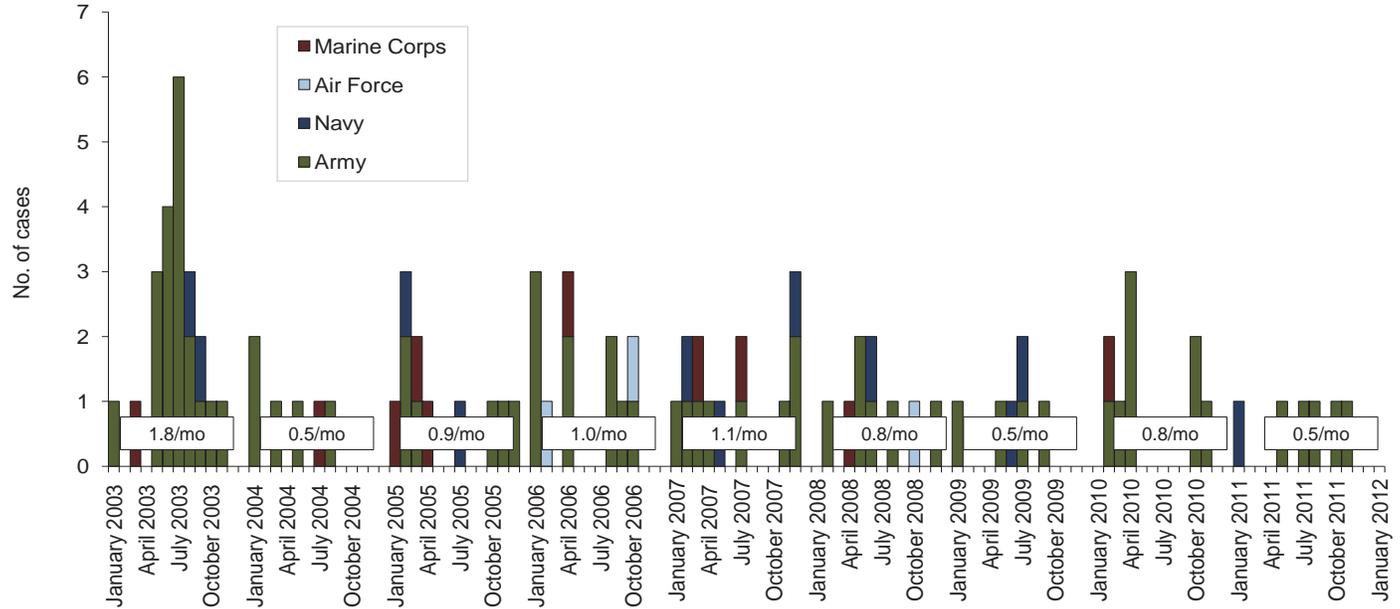


Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002-2007. *MSMR*. Aug 2007; 14(5):7-9.
^bOne diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 365 days of returning from OEF/OIF/OND.

Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003 - January 2012 (data as of 23 February 2012)

Note: The numbers of OEF/OIF/OND deployment-associated conditions in this report differ from those previously published in the *MSMR*. The change reflects an adjustment in the manner in which service members' deployments were associated with OEF/OIF/OND. The net effect is to decrease the numbers of service members with the conditions of interest who could be identified as having deployed to OEF/OIF/OND.

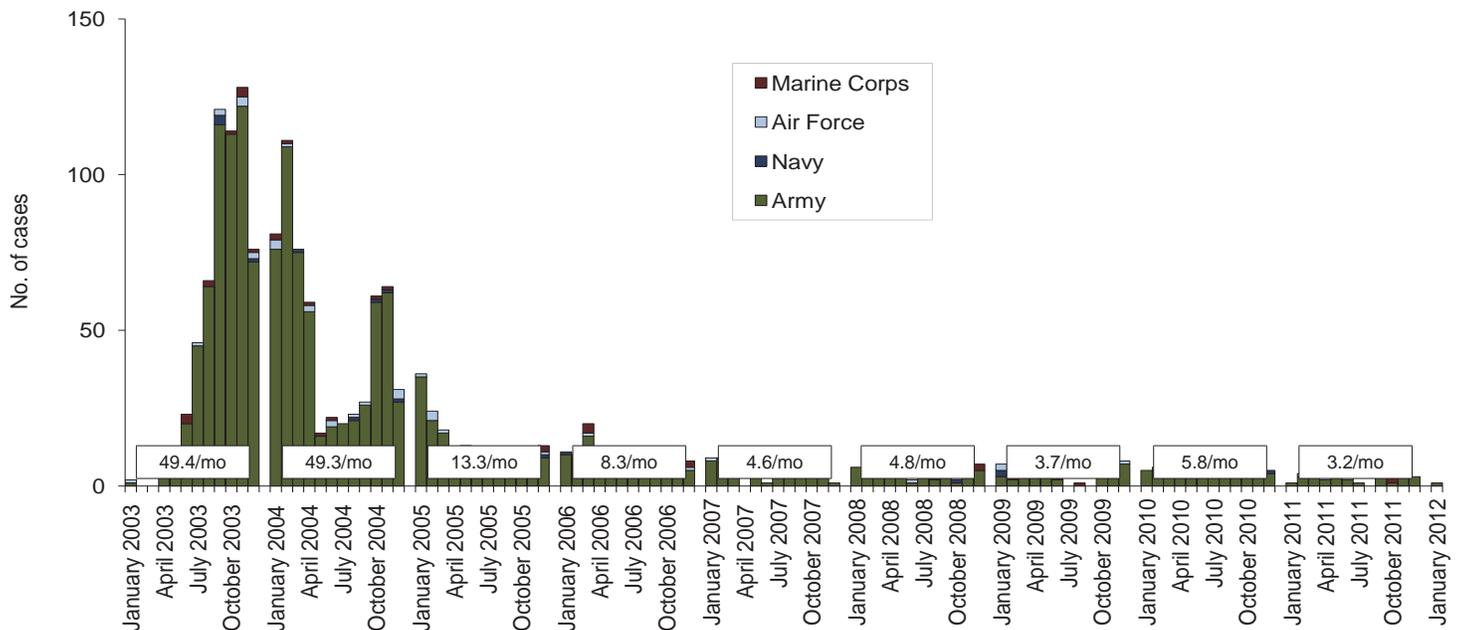
Severe acute pneumonia (ICD-9: 518.81, 518.82, 480-487, 786.09)^a



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: severe acute pneumonia. Hospitalizations for acute respiratory failure (ARF)/acute respiratory distress syndrome (ARDS) among participants in Operation Enduring Freedom/Operation Iraqi Freedom, active components, U.S. Armed Forces, January 2003-November 2004. *MSMR*. Nov/Dec 2004;10(6):6-7.

^aIndicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF/OND.

Leishmaniasis (ICD-9: 085.0 to 085.9)^b



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003-November 2004. *MSMR*. Nov/Dec 2004;10(6):2-4.

^bIndicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF/OND.

Medical Surveillance Monthly Report (MSMR)

Armed Forces Health Surveillance Center
11800 Tech Road, Suite 220 (MCAF-CS)
Silver Spring, MD 20904

Director, Armed Forces Health Surveillance Center

CAPT Kevin L. Russell, MD, MTM&H,
FIDSA (USN)

Editor

Francis L. O'Donnell, MD, MPH

Contributing Former Editor

John F. Brundage, MD, MPH

Writer-Editor

Ellen R. Wertheimer, MHS
Denise S. Olive, MS

Contributing Editor

Leslie L. Clark, PhD, MS

Visual Information Specialist

Jennifer L. Bondarenko

Data Analysis

Stephen B. Taubman, PhD
Gi-Taik Oh, MS
Monique-Nicole Anthony, MPH

Editorial Oversight

COL Robert J. Lipnick, MSS, ScD (USA)
Mark V. Rubertone, MD, MPH
Joel C. Gaydos, MD, MPH

THE MEDICAL SURVEILLANCE MONTHLY REPORT (MSMR), in continuous publication since 1995, is produced by the Armed Forces Health Surveillance Center (AFHSC). The *MSMR* provides evidence-based estimates of the incidence, distribution, impact and trends of illness and injuries among United States military members and associated populations. Most reports in the *MSMR* are based on summaries of medical administrative data that are routinely provided to the AFHSC and integrated into the Defense Medical Surveillance System for health surveillance purposes.

All previous issues of the *MSMR* are available online at www.afhsc.mil. Subscriptions (electronic and hard copy) may be requested online at www.afhsc.mil/msmrSubscribe or by contacting AFHSC at (301) 319-3240. E-mail: msmr.afhsc@amedd.army.mil

Submissions: Instructions to authors are available at www.afhsc.mil/msmr.

All material in the *MSMR* is in the public domain and may be used and reprinted without permission. Citation formats are available at www.afhsc.mil/msmr

Opinions and assertions expressed in the *MSMR* should not be construed as reflecting official views, policies, or positions of the Department of Defense or the United States Government.

ISSN 2158-0111 (print)
ISSN 2152-8217 (online)

