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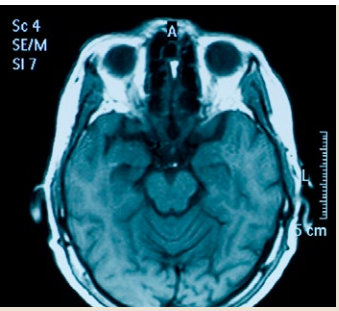

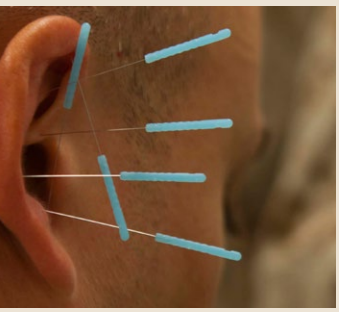

Increasing Severity of Traumatic Brain Injury Is Associated with an Increased Risk of Subsequent Headache or Migraine: A Retrospective Cohort Study of U.S. Active Duty Service Members, 2006–2015

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Traumatic brain injury (TBI) is a common injury in the U.S. Compared to the general population, military service members can be at increased risk for TBI because of the nature of their work. Sequelae of TBI, such as headache or migraine, can lead to military duty limitations or separation from service. To determine whether the severity of TBI is associated with the risk of these sequelae, this 2006–2015 retrospective cohort study compared the incidence of diagnosed headache or migraine among all service members with a first-time mild or moderate/severe TBI (N=111,018) against a matched sample without any history of TBI. Risk increased according to the severity of TBI. Compared to service members without TBI, those who sustained a mild TBI were 3.99 times more likely to have a headache or migraine, and those with a moderate/severe TBI were 8.89 times more likely. Patients, medical providers, and military leaders can use these results to guide care after a TBI. Early identification of those at higher risk of these sequelae could improve medical management and reduce disability.

The Department of Defense (DoD) defines traumatic brain injury (TBI) as a "traumatically induced structural injury and/or physiological disruption of brain function as a result of an external force that is indicated by new onset or worsening of at least one of the following clinical signs immediately following the event: any period of loss of or decreased level of consciousness; any loss of memory for events immediately before or after the injury; any alteration in mental state at the time of the injury (confusion, disorientation, slowed thinking, etc.); neurological deficits (weakness, loss of balance, change in vision, praxis, paresis/plegia, sensory loss, aphasia, etc.) that may or may not be transient; intracranial lesion."[1]

TBI is a common injury in the U.S. Among civilians, 1.7 million people suffer a TBI each year; of those, 275,000 are hospitalized and 53,000 die of their injuries.[2] In the U.S. Armed Forces, between 2000 and 2012, more than 200,000 military members sustained a TBI; of those, more than 13,000 were hospitalized.[3]

TBI can occur in any setting. In the general population, the leading causes of TBI are falls (41%), unintentional blunt trauma (such as being hit by a falling object) (16%), motor vehicle collisions (14%), and assaults (11%).[4] Military service members can face additional risks because of the nature of their work. Blast-related injuries sustained in war,[5,6] intense contact sports, and combat training can also lead to TBI.[7,8]

Headache and migraine are commonly reported symptoms following TBI, both in civilian[2,9–11] and military settings,[2,3] and can contribute to both prolonged and sometimes permanent disability. A history of recurrent headaches and of migraines can both prevent accession to the armed forces, or for those already enrolled, lead to duty limitations or separation from service.[12]

Previous survey-based studies suggest that TBI associated with blast is more likely to be associated with impaired memory, altered reaction time, and post-traumatic stress disorder (PTSD) than TBI not associated with blast.[6] However, it is unclear whether increased severity of TBI is associated with increased risk of headache or migraine.[13,14] Knowledge of whether a dose-response relationship exists between TBI and headache or migraine risk may help providers and patients better anticipate and manage these sequelae of TBI. If such a relationship exists, military medical personnel may be able to better predict the ability of a service member to return to unrestricted duty on the basis of the severity of the TBI. Thus, this analysis sought to determine whether increasing severity of TBI is associated with an increased risk of headache or migraine.

METHODS

The surveillance period was 1 January 2006 through 31 December 2015. Incident cases of TBI that occurred during 2006–2014 were identified. For each TBI case, there was a 1-year follow-up period to detect any subsequent diagnoses of headache or migraine. The 1-year follow-up periods extended through 31 December 2015. The surveillance population included all active component Army, Navy, Air Force, and Marine Corps service members during the surveillance period who had no prior history of medical care for TBI, headache, or migraine documented in administrative medical records during their time in active service.

Data were obtained from the Defense Medical Surveillance System (DMSS), a longitudinal administrative data warehouse

that contains electronic medical records of hospitalizations and ambulatory medical encounters in military medical treatment facilities, civilian facilities (if care was reimbursed through the Military Health System), and in the deployed setting if documented in the Theater Medical Data Store (TMDS).

This was a retrospective cohort study. To define the exposed population groups, incident diagnoses of mild TBI and moderate/severe TBI were identified from ICD-9 diagnostic codes recorded during hospitalizations and ambulatory medical encounters **(Table 1)**, using case definitions developed by the Armed Forces Health Surveillance Branch (AFHSB) for surveillance purposes.[15] Each individual's first encounter that included a diagnosis of TBI was used as the starting point for surveillance for headache or migraine for that individual. Because the available data do not distinguish between follow-up visits for an initial TBI and new episodes of TBI, the potential for recurrent TBI could not be considered. Thus, the exposed cohorts include only those diagnosed with their first TBI. To define an unexposed comparison cohort, for each person with TBI another service member of the same age and sex, but without any history of TBI, headache, or migraine, was randomly selected and matched on a 1:1 basis. Because of data processing limitations, this comparison group was drawn from a random sample of 25% of all service members without any history of TBI, headache, or migraine.

To determine the incidence of headache or migraine in the exposed and unexposed comparison groups, encounters were identified from either ICD-9 (before 1 October 2015) or ICD-10 (after 1 October 2015) diagnostic codes recorded during hospitalizations and ambulatory medical encounters **(Table 2)**. Previous studies have shown that the majority of people who sustain a TBI that does not lead to long-term clinically significant sequelae are symptom free within 2 weeks.[16–18] Therefore, to focus on headaches or migraines associated with TBI at higher risk for longer-term symptoms that could interfere with recovery and military duty, only those encounters for headache or migraine occurring after 14 days following the TBI event (or the date of matching) were counted.

TABLE 1. ICD–9/ICD–10 diagnostic codes used to define traumatic brain injury (TBI) exposure groups (moderate/severe, mild, or no TBI)

Diagnosis	ICD–9 codes	ICD–10 codes
TBI, moderate/severe	800.03–800.05, 800.1x–800.4x, 800.53–800.59, 800.6x–800.9x, 801.03–801.05, 801.1x–801.4x, 801.53–801.59, 801.6x–801.9x, 803.03–803.05, 803.1X–803.4x, 803.53–803.59, 803.6x–803.9x, 804.03–804.05, 804.1X–804.4x, 804.53–804.59, 804.6x–804.9x, 850.12, 850.2, 850.3, 850.4, 851.xx–854.xx	S04.02, S04.03, S04.04, S06.0X2A–8A, S06.1, S06.2, S06.3, S06.4, S06.5, S06.6, S06.89, S06.9, S02.0, S02.1, S02.110B, S02.111, S02.112B, S02.113, S02.118, S02.119, S02.19, S02.8XXB, S02.91, S07.1
TBI, mild	905.0, V80.01, 800.00–800.02, 800.06, 800.09, 800.50–800.52, 801.00–801.02, 801.06, 801.09, 801.50–801.52, 803.00–803.02, 803.06, 803.09, 803.50–803.52, 804.00–804.02, 804.06, 804.09, 804.50–804.52, 850.0, 850.01, 850.11, 850.5, 850.9, 851.0, 950.1–950.3,950.01	F07.81, S06.0X0A, S06.0X1A, S06.0X9A, S02.110A, S02.112A, S02.113A, S02.8XXA, Z87.820
No TBI	No diagnosis of any of the above codes	

As primary analysis, the relative risk of headache or migraine in those with a mild TBI and a moderate/severe TBI was calculated by comparing their incidence to the incidence among service members who had not sustained a TBI. Analyses were adjusted for age, sex, rank group, and branch of service. It was reasoned a priori that results may vary according to deployment history. Because service members who deploy are subject to medical screening before departure, they may tend to be healthier at baseline than those who do not deploy. To assess this potential effect, data were stratified into those with and without a history of deployment and analyzed separately. Similarly, previous studies have shown that service members with a history of post-traumatic stress disorder (PTSD) tend to report greater severity of symptoms after a TBI than those without PTSD,[19] perhaps because of reduced cognitive reserve.[20] Moreover, PTSD and TBI symptoms often overlap, and in some cases may be attributed by the patient to the same traumatic event.[21] PTSD history was therefore used as a covariate in adjusted models.

As a secondary analysis, the frequency of encounters for headache or migraine was calculated in the exposed and matched unexposed groups in each week following the TBI event to determine the overall demand over time for care at medical treatment facilities. To assess whether time to first encounter for headache or migraine differed by TBI exposure, survival curves were plotted for each of the exposure groups.

TABLE 2. ICD-9/ICD-10 diagnostic codes used to define outcome events (headache, migraine)

Diagnosis	ICD-9 codes	ICD-10 codes
Headache	307.81, 339.00–339.09, 339.1x, 339.2x, 339.4x, 339.8x, 784.xx (exclude 339.3x, drug-induced headache)	G44.xx (exclude G44.4x, drug-induced headache), R51
Migraine	346.xx	G43.xx

RESULTS

During the surveillance period, a total of 111,018 service members received first-time diagnoses of TBI **(Table 3)**. Mild TBI was diagnosed in 102,055 (91.9%), while moderate/severe was diagnosed in

8,963 (8.1%). The majority of TBI diagnoses were assigned to men (102,279), those serving in the Army (61,724), those younger than 24 years of age (61,388), and to members of the junior enlisted (E1–E4) rank group (68,133). More than a quarter (27.3%) of those who were diagnosed with a moderate/severe TBI were diagnosed with a headache or migraine during the post-TBI 1-year follow-up period, compared to 15.2% of those who sustained a mild TBI, and 3.3% of the matched cohort that did not have a TBI **(Table 4)**.

During the 1-year follow-up periods for service members enrolled in the study cohorts for 2006–2014, the annual incidence rates of headache or migraine remained roughly constant among service members who did not have a TBI, from 315 cases per 10,000 person-years (p-yrs) in the 2006 group to 330 per 10,000 p-yrs in the 2014 group **(Figure 1)**. During the same period, annual incidence rose from 1,084 per 10,000 p-yrs to 1,769 per 10,000 p-yrs among those with a mild TBI, while for those with a moderate/severe TBI, the annual incidence rates more than doubled from 2,283 per 10,000 p-yrs to 4,819 per 10,000 p-yrs. Particularly among those who had a moderate/severe TBI, rates for those who had ever deployed were generally higher than those who had never deployed.

Among all service members who sustained a TBI, the relative risk of headache or migraine was greater than that of members of the comparison cohort who did not sustain a TBI. Risk increased according to the severity of TBI. Those who sustained a mild TBI were approximately four times (adjusted relative risk [ARR]: 3.99 [95% CI: 3.85–4.14]) more likely to have a headache or migraine, and those with a moderate/severe TBI were almost nine times (ARR: 8.89 [95% CI: 8.42–9.40]) more likely **(Figure 2)**.

Relative risk of headache or migraine differed by deployment history. Service members who had ever deployed had greater increases in relative risk than those who had never deployed **(Figure 2)**. Among those who had deployed, a mild TBI was associated with an almost five-fold (ARR: 4.65 [95% CI: 4.44–4.88]) increase in the risk of headache or migraine, compared to those with no history of TBI, while a 10-fold (ARR: 10.10 [95% CI: 9.42–10.82]) increase was seen in those with severe TBI. Among service members who had never deployed, those with a mild TBI were almost three times (ARR: 2.92 [95% CI: 2.75–3.11]) more likely to have headache or migraine, compared to those with

TABLE 3. Demographic and military characteristics of service members by traumatic brain injury (TBI) cohort, active component, U.S. Armed Forces, 2006–2014

	No TBI		TBI, mild		TBI, moderate/severe	
	N	Col %	N	Col %	N	Col %
All	111,018	100.0	102,055	100.0	8,963	100.0
Service						
Army	38,656	34.8	56,993	55.9	4,731	52.8
Navy	27,514	24.8	14,142	13.9	1,293	14.4
Air Force	25,049	22.6	12,573	12.3	1,053	11.8
Marines	19,799	17.8	18,347	18.0	1,886	21.0
Sex						
Male	102,279	92.1	93,816	91.9	8,463	94.4
Female	8,739	7.9	8,239	8.1	500	5.6
Race/ethnicity						
White, non-Hispanic	80,014	72.1	77,927	76.4	7,019	78.3
Black, non-Hispanic	16,163	14.6	12,383	12.1	943	10.5
Other	14,841	13.4	11,745	11.5	1,001	11.2
Age group						
<24	61,388	55.3	56,306	55.2	5,082	56.7
25–34	36,813	33.2	33,972	33.3	2,841	31.7
35–44	10,891	9.8	10,013	9.8	866	9.7
45–54	1,814	1.6	1,669	1.6	159	1.8
55+	112	0.1	95	0.1	15	0.2
Rank						
Junior Enlisted (E1–E4)	64,455	58.1	62,667	61.4	5,466	61.0
Senior Enlisted (E5–E9)	31,471	28.4	31,083	30.5	2,737	30.5
Junior Officer (O1–O4)	12,279	11.1	6,633	6.5	598	6.7
Senior Officer (O5–O10)	1,899	1.7	962	0.9	89	1.0
Warrant Officer (W1–W5)	914	0.8	710	0.7	73	0.8
Marital status						
Married	50,965	45.9	48,060	47.1	3,896	43.5
Single	57,179	51.5	50,289	49.3	4,708	52.5
Other	2,874	2.6	3,706	3.6	359	4.0
Occupation						
Combat	23,824	21.5	34,041	33.4	3,340	37.3
Health care	7,062	6.4	5,822	5.7	481	5.4
Other	80,132	72.2	62,192	60.9	5,142	57.4
Post-traumatic stress disorder						
No	109,246	98.4	89,558	87.8	7,647	85.3

TABLE 4. Incident diagnoses of headache/migraine, active component, U.S. Armed Forces, by exposure to traumatic brain injury (TBI), January 2006–December 2014

	No. of subjects	No. of subjects who developed headache/migraine	% of total who developed headache/migraine
No TBI	111,018	3,665	3.3%
TBI, mild	102,055	15,519	15.2%
TBI, moderate/severe	8,963	2,449	27.3%

FIGURE 1. Annual incidence of headache/migraine, by year of injury, according to history and severity of traumatic brain injury (TBI), and history of prior deployment, active component, U.S. Armed Forces, 2006–2014

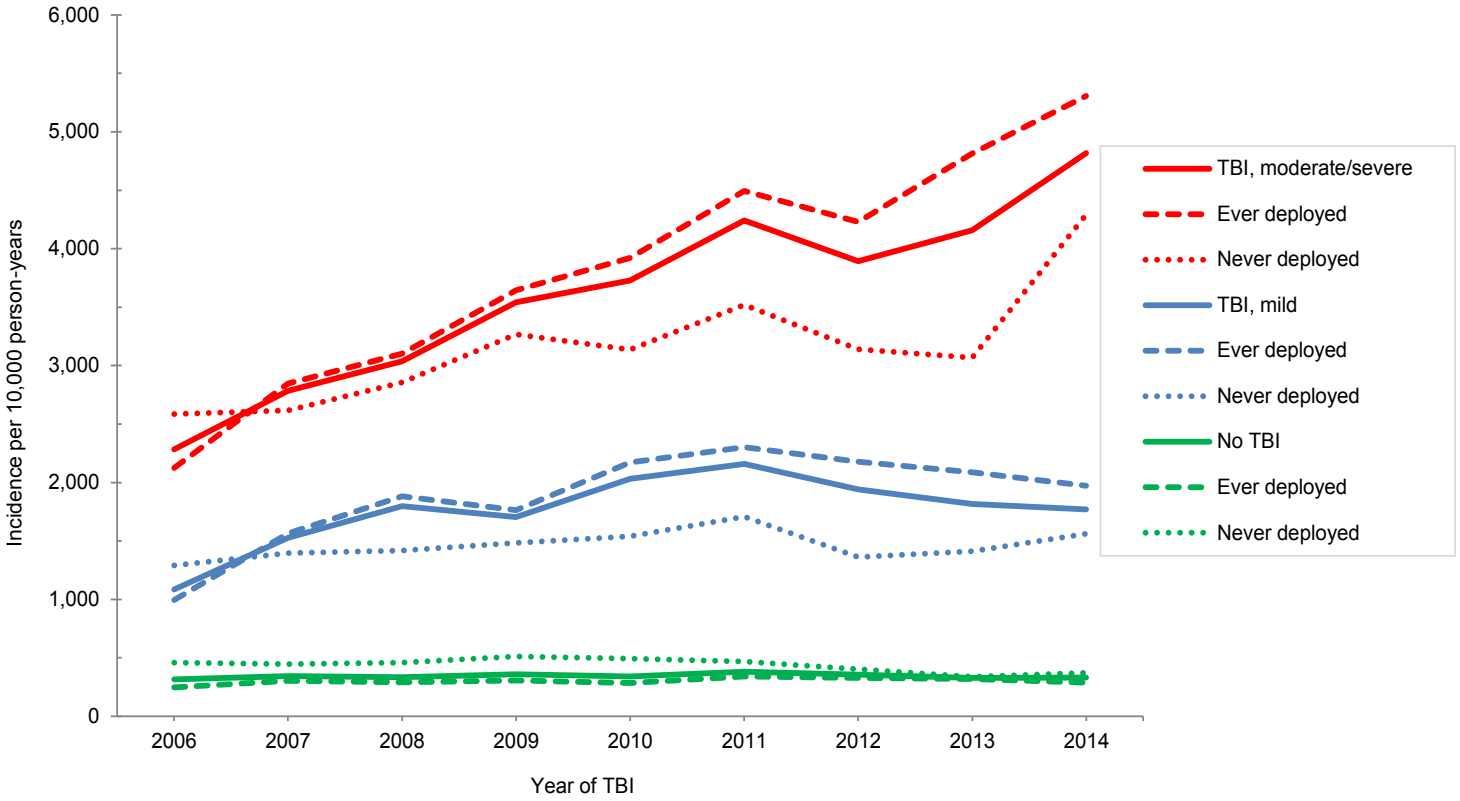
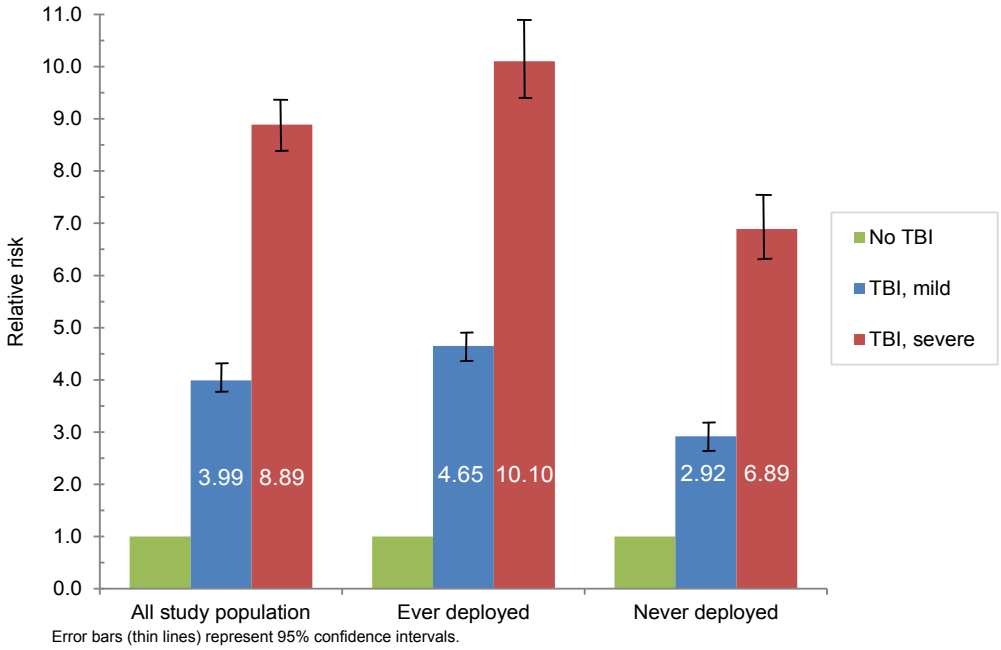


FIGURE 2. Adjusted relative risk of developing headache/migraine after a traumatic brain injury (TBI) compared to those without TBI, in all TBI cases, in TBI cases who had ever deployed, and in TBI cases who had never deployed, by year of injury, active component, U.S. Armed Forces, 2006–2014



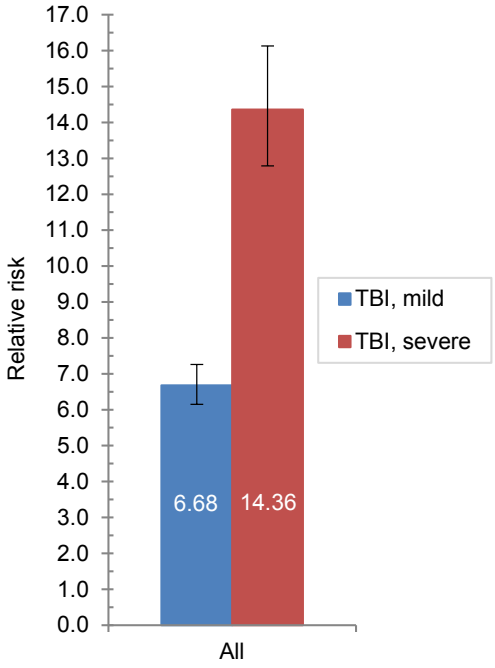
Error bars (thin lines) represent 95% confidence intervals.

no history of TBI, while those with severe TBI were almost seven times (ARR: 6.89 [95% CI: 6.27–7.56]) more likely **(Figure 2)**.

Among service members who had deployed, those whose incident TBI occurred during deployment were at even higher risk (mild ARR: 6.68 [95% CI: 6.15–7.26]; severe ARR: 14.36 [95% CI: 12.79–16.13]) of headache or migraine, compared to those with no history of TBI **(Figure 3)**. Among those with PTSD, the relative risk increases for headache/migraine after a mild or moderate/severe TBI remained statistically significant but were attenuated to 2.11 (95% CI: 2.03–2.19) and 1.69 (95% CI: 1.55–1.85), respectively **(data not shown)**.

The majority of initial presentations for headache or migraine following a TBI occurred within the first 15 weeks after the TBI **(Figure 4)**. The survival curves showing proportion of symptom-free individuals varied by TBI severity **(Figure 5)**. The

FIGURE 3. Adjusted relative risk of headache/migraine after a traumatic brain injury (TBI) during deployment compared to those without TBI, active component, U.S. Armed Forces, 2006–2014



Error bars (thin lines) represent 95% confidence intervals.

time frame during which service members presented with headache or migraine shortened according to the severity of TBI they sustained: half of those with a moderate/severe TBI who would eventually report headache or migraine did so within 12 weeks of the TBI. In those with a mild TBI, this point was reached at around 15 weeks.

EDITORIAL COMMENT

This study found that the relative risk of presenting for medical care for a new headache or migraine after a TBI increased according to the severity of the TBI: the more severe the TBI, the greater the likelihood of receiving a new diagnosis of headache or migraine. The results also provided new information regarding the need for and timing of follow-up for headache or migraine after a TBI across the active component military population, which may help planning for medical service needs.

It was anticipated a priori that service members who had deployed would have smaller increases in relative risk following TBI. Because of pre-deployment screening and selection processes, those who deploy tend to be healthier than those who do not, and better health may reduce the likelihood for post-TBI sequelae. In fact, those who deployed were shown to be at greater risk for headache or migraine after TBI than those who had not deployed. This observation could be due to differences in mechanisms of TBI. Blast- and combat-related TBI are presumed to be more likely among deployers than non-deployers. Moreover, because of the interest in disability tracking, surveillance and injury reporting may be more robust among those who deploy. The greater rise in relative risk of headache or migraine after TBI incurred during deployment, compared to TBI sustained outside of a deployment, is consistent with either explanation.

The dose-response relationship between TBI severity and risk of headache or migraine was attenuated for those with PTSD. As previous studies have shown that

FIGURE 4. Numbers of initial and follow-up encounters for headache/migraine and cumulative proportions of such encounters during the 1-year follow-up period, by week after initial diagnoses of traumatic brain injury (TBI), active component, U.S. Armed Forces, 2006–2014

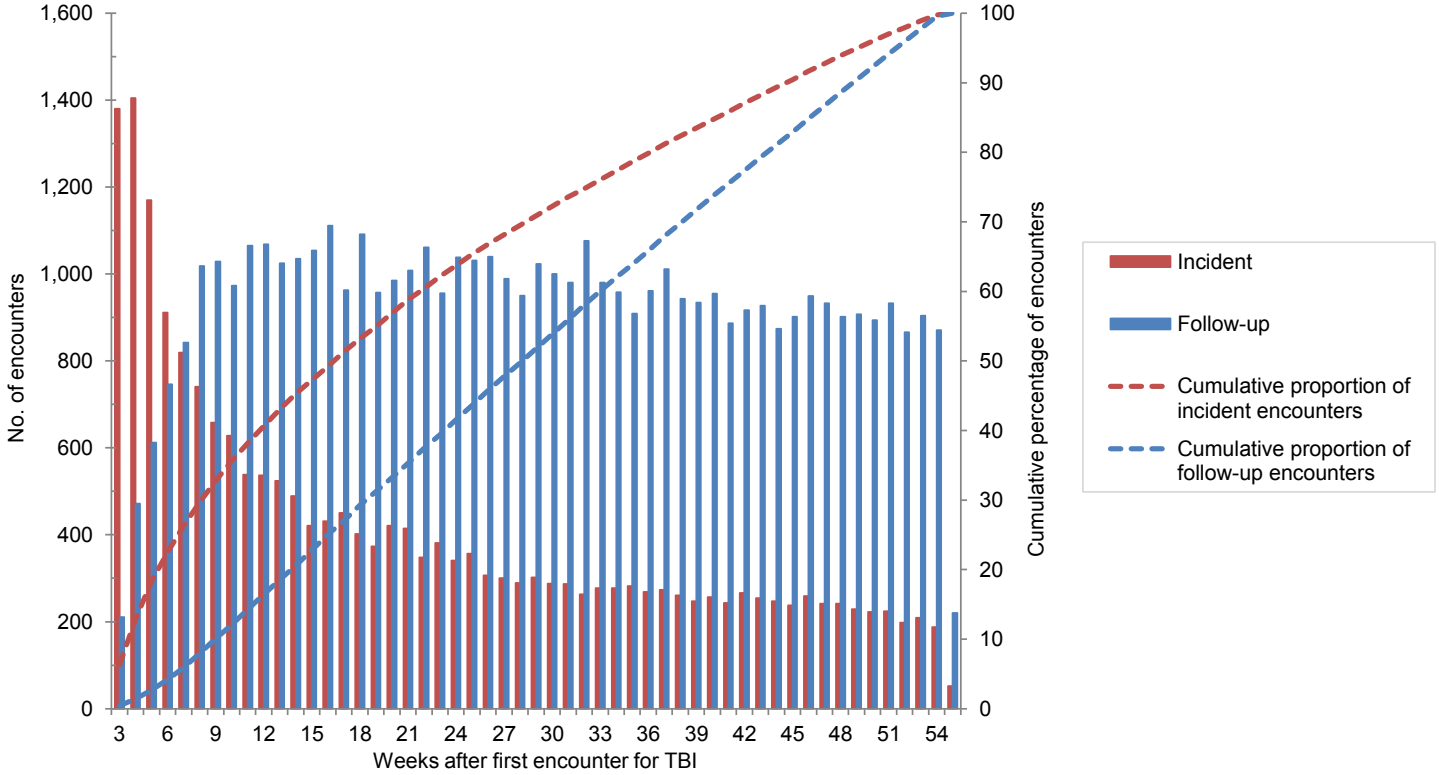
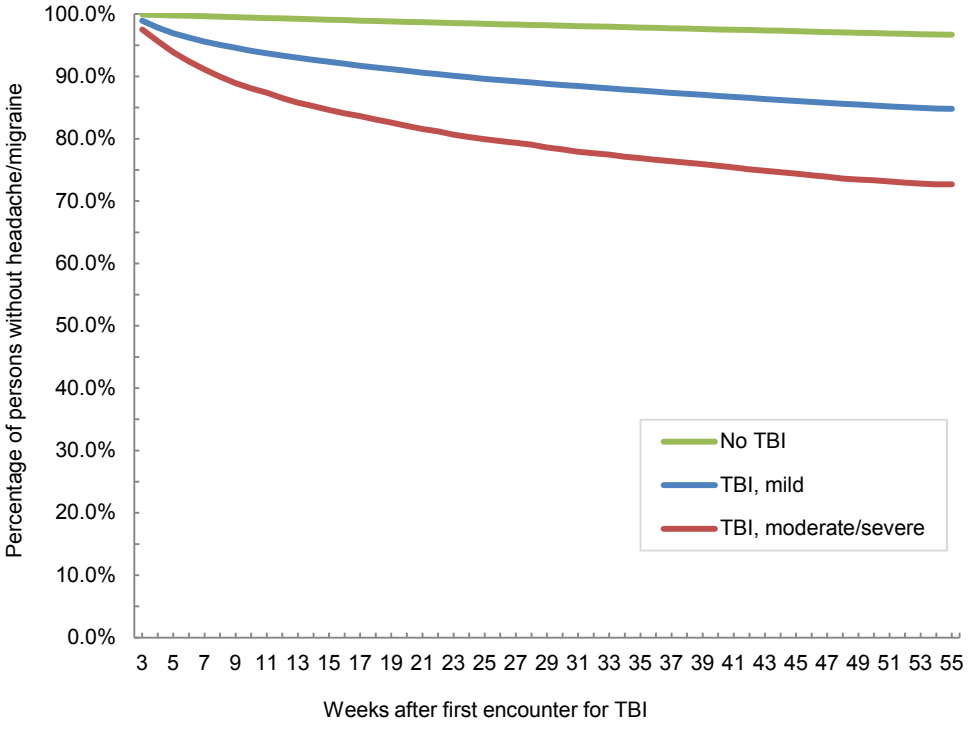


FIGURE 5. Percentage of subjects in each of the study groups (mild traumatic brain injury [TBI], moderate/severe TBI, no TBI) who had not been diagnosed with headache/migraine during each of the weeks during the 1-year follow-up period, active component, U.S. Armed Forces, 2006–2014



those with PTSD report greater severity of symptoms following TBI— including headache and migraine—the change in the relative risk rise following TBI shown here is not unexpected, and reinforces the understanding that PTSD influences how service members recover after an injury.

As expected, the majority of initial presentations for headache or migraine following a TBI occurred earlier in the year of follow-up rather than later. Half of those who would develop headache or migraine did so within the first 12 weeks, and two-thirds by week 19. This observation suggests that patients and providers should continue to anticipate presentation for these symptoms as late as 3 months after a TBI.

This study is subject to certain limitations. Because the analysis used administrative data only, it was impossible to address questions that would require review of patient history or clinical records, such as the effect of recurrent TBI on a service member's risk for headache or migraine, the potential reclassification of a TBI severity during a subsequent visit as symptoms ensue, the severity of the headache or migraine itself, whether frequency of follow-up relates to symptom severity, and so on. Most importantly, the association between TBI and headache or migraine does not prove causation.

Given the potential for headache and migraine to lead to duty limitations following a TBI, especially over the long term, patients, military leaders, and medical providers can use this knowledge to anticipate not only the health needs and return to duty of injured service members, but also the implications for their careers and the overall strength of the military as well. Medical service planners can use post-injury follow-up projections to ensure that resources are made available to meet anticipated needs. Service members who sustain a TBI and their leaders may find it helpful to understand the risk of headache and migraine following TBI and the expected time frame for presentation, and to gauge the potential for symptoms, their need for medical attention, and their likelihood to be able to perform unrestricted duty.

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Use of Complementary Health Approaches at Military Treatment Facilities, Active Component, U.S. Armed Forces, 2010–2015

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Survey-based research has demonstrated the increasing use and acceptance of complementary and alternative medicine (CAM) in general and military populations. This report summarizes the use of three CAM procedures (chiropractic/osteopathic manipulation, acupuncture, and biofeedback) among active component service members from 2010 through 2015. Findings document a marked increase in the use of chiropractic/osteopathic manipulation and acupuncture procedures since 2010. The majority of the 240 military installations in this analysis provided chiropractic/osteopathic manipulation; more than three-quarters provided acupuncture; and approximately one-third provided biofeedback procedures. "Other and unspecified disorders of the back" was the most frequent condition for which chiropractic/osteopathic manipulation and acupuncture were used. "Non-allopathic lesions not elsewhere classified" was the second most frequent diagnosis during chiropractic/osteopathic manipulation–related visits. The second and third most frequent diagnoses during acupuncture-related visits were "acute and chronic pain" and "adjustment reaction," respectively. "Adjustment reaction" was the second most frequent diagnosis associated with biofeedback. Continued research is needed to gain a better understanding of why military personnel are using CAM and the role these procedures play in their health care.

Complementary health approaches, also known as complementary and alternative medicine (CAM), are terms used to describe a diverse group of practices and products with a history of use or origins outside of conventional Western medicine.[1] The use of CAM procedures has been increasing among the general adult population. In 2002, 2007, and 2012, estimates of the percentage of U.S. adults aged 18 years and older who used any complementary health approach in the previous 12 months were 32.3%, 35.5%, and 33.2%, respectively.[1,2] Trends in the U.S. military mirror those reported in the general population. A survey-based study of U.S. Navy and Marine Corps personnel using data from December 2000 through July 2002 reported that more than one-third (37.2%) of the respondents had used at least one CAM procedure in the preceding year.[3] The 2005 Department of Defense (DoD) Survey of Health Related Behaviors Among Active Duty Military Personnel yielded a prevalence estimate of 44.5% for any CAM (without prayer) use.[3,4]

In September 2008, the *MSMR* summarized the number and nature of CAM procedures during ambulatory visits of U.S. military members in 2006 and 2007.[5] Since that time, survey-based research has further demonstrated the increasing use and acceptance of these approaches in the general and military populations.[6–8] For example, results of a 2012 survey of military personnel and family members presenting to an Emergency Department in a tertiary military treatment facility (MTF) indicate that 45% of respondents described previous or current CAM use.[9] Furthermore, in the past decade, the DoD has funded additional research into the use of CAM approaches such as acupuncture and chiropractic manipulation in the treatment of an array of conditions common to the military population, including post-traumatic stress disorder, traumatic brain injury, and chronic pain syndromes in a wide range of settings including while deployed.[10–13] Despite this increased research focus, few studies have used medical administrative data to assess the use of complementary health approaches in the U.S. military.

This report describes trends in the use of three complementary health approaches by active service members during healthcare encounters over a 6-year surveillance period, from 2010 through 2015. The modalities of interest include chiropractic/osteopathic manipulation, acupuncture, and biofeedback. These modalities were selected because they are three of the most commonly used approaches in both the U.S. general and military populations and are documented with a discrete set of standardized procedure (CPT) codes. In addition, this report characterizes patterns of use with regards to treatment location (military installation), key demographic characteristics (age, gender, race/ethnicity, education level, service, military status, and occupation) of CAM recipients, and treated conditions.

METHODS

The surveillance period was 1 January 2010 through 31 December 2015. The surveillance population included all individuals who served in the active component of the U.S. Army, Navy, Air Force, or Marine Corps anytime during the surveillance period. Records of all healthcare encounters (hospitalizations and ambulatory visits) maintained in the Defense Medical Surveillance System (DMSS) that included CPT codes that documented CAM procedures of interest (acupuncture, chiropractic/osteopathic manipulation, and biofeedback) were identified **(Table 1)**. The analysis was restricted to direct care encounters at U.S. military medical facilities; as such, it did not include encounters at civilian facilities (e.g., purchased/outsourced care).

For all healthcare encounters of interest, relevant CPT codes in all procedure positions of the electronic records of the encounters (i.e., outpatient CPT 1–4; inpatient PCS 1–20) were identified. To ascertain CAM use during combat-related deployments, records of medical encounters maintained in the Theater Medical Data Store (TMDS) were searched; no CAM procedures of interest were documented in the TMDS during the surveillance period.

The illnesses and injuries that were treated with CAM procedures were characterized using three-digit groupings for ICD-9 and four-character groupings for ICD-10. CAM use was summarized as the proportion of active component members who had at least one healthcare encounter that included a CAM procedure of interest and as the number of CAM procedure-related visits per 100 service members per year.

RESULTS

During the 6-year surveillance period, 14.9% (n=358,394) of active component service members had at least one healthcare encounter that included a CAM procedure of interest (chiropractic/osteopathic manipulation, acupuncture, or biofeedback) **(data not shown)**. Among all active component members during this period, slightly more than one-eighth (12.8%; n=307,897) had at least one ambulatory visit that included a chiropractic/osteopathic manipulation procedure; approximately 2% (n=46,950) had at least one visit that included acupuncture; and nearly 1% (0.9%; n=22,209) had a visit that included biofeedback **(Table 2)**. Very few (0.04%) of all healthcare encounters that included acupuncture procedures were associated with inpatient care **(data not shown)**.

In general, members of the Air Force and Army, women, senior enlisted members and officers, service members aged 30 years or older, those with an education level of some college or more, and those in healthcare and pilot/air crew occupations were more likely than their respective counterparts to have had outpatient visits with chiropractic/osteopathic manipulations **(Table 2)**. Overall, active members of the Army, women, senior enlisted members and senior officers, those aged 30 years or older, and those in healthcare occupations were more likely than their respective counterparts to have had acupuncture procedure-related visits **(Table 2)**. The most pronounced differences in the proportions of service members with outpatient visits that included biofeedback procedures were by service; active members of the Army were approximately 10.5, 5.9, and 3.7 times more likely to have biofeedback procedures during medical encounters than Navy, Air Force, and Marine Corps members, respectively **(Table 2)**.

Chiropractic/osteopathic manipulation (n=1,768,621 visits) accounted for 88.0% of all encounters for which CAM procedure codes were listed; such encounters were 10 and 26 times more frequent than encounters coded for acupuncture (8.7%; n=175,679) and biofeedback (3.3%; n=66,149) visits, respectively **(data not shown)**. Numbers of CAM procedure-related visits per 100 service members per year (per 100/yr) for chiropractic/osteopathic manipulation procedures more than doubled from 2010 (10.3 per 100/yr) to 2015 (24.5 per 100/yr) **(Table 3)**. Annual utilization rates of such visits were consistently nearly twice as high among females than males, and they generally increased with age and with formal educational attainment **(Table 3)**. Also, rates were consistently higher among service members who were white, non-Hispanic; in the Air Force or Army; senior enlisted or officers; and in healthcare and pilot/air crew occupations, compared to their respective counterparts **(Table 3)**.

Annual rates of visits that included acupuncture procedures were more than

TABLE 1. ICD-9/ICD-10 procedure codes used for classification

Complementary alternative medicine modality	ICD-9	ICD-10
Chiropractic/osteopathic manipulation	CPT 98940, 98941, 98942 [spinal], 98943 [extra spinal]	Same CPT codes
	CPT 98925 [1–2 body regions], 98926 [3–4 body regions], 98927 [5–6 body regions], 98928 [7–8 body regions], 98929 [9–10 body regions]	Same CPT codes
Acupuncture	CPT 97810, 97811, 97813, 97814	Same CPT codes
	PCS 99.91 [for anesthesia], 99.92 ["other"]	8E0H300 and 8E0H30Z
Biofeedback	CPT 90901 [any modality of biofeedback except pelvic floor training for the treatment of incontinence]	Same CPT code

TABLE 2. Number and proportion of service members who had healthcare encounter(s) that included chiropractic/osteopathic manipulation-, acupuncture-, or biofeedback-related procedures, active component, U.S. Armed Forces, 2010–2015

	Chiropractic/osteopathic manipulation			Acupuncture			Biofeedback		
	Total 2010–2015			Total 2010–2015			Total 2010–2015		
	No. of service members	No. of recipients	% of service members	No. of service members	No. of recipients	% of service members	No. of service members	No. of recipients	% of service members
Total	2,410,729	307,897	12.8	2,410,729	46,950	1.9	2,410,729	22,209	0.9
Service									
Army	961,009	145,898	15.2	961,009	23,696	2.5	961,009	17,703	1.8
Navy	553,490	42,838	7.7	553,490	8,360	1.5	553,490	970	0.2
Air Force	510,875	86,863	17.0	510,875	9,490	1.9	510,875	1,607	0.3
Marine Corps	385,355	32,298	8.4	385,355	5,404	1.4	385,355	1,929	0.5
Sex									
Male	2,035,092	240,479	11.8	2,035,092	34,861	1.7	2,035,092	17,649	0.9
Female	375,637	67,418	17.9	375,637	12,089	3.2	375,637	4,560	1.2
Race/ethnicity									
White, non-Hispanic	1,474,604	196,133	13.3	1,474,604	29,097	2.0	1,474,604	13,215	0.9
Black, non-Hispanic	386,256	47,576	12.3	386,256	7,088	1.8	386,256	4,530	1.2
Hispanic	299,338	33,424	11.2	299,338	5,728	1.9	299,338	2,813	0.9
American Indian/Alaskan Native	26,386	3,138	11.9	26,386	555	2.1	26,386	157	0.6
Asian/Pacific Islander	90,408	12,393	13.7	90,408	2,033	2.2	90,408	799	0.9
Unknown race/ethnicity	133,737	15,233	11.4	133,737	2,449	1.8	133,737	695	0.5
Age									
<20	252,264	7,250	2.9	252,264	416	0.2	252,264	642	0.3
20–24	948,716	71,445	7.5	948,716	7,795	0.8	948,716	4,819	0.5
25–29	517,826	75,774	14.6	517,826	10,744	2.1	517,826	5,574	1.1
30–34	272,723	55,524	20.4	272,723	9,019	3.3	272,723	4,100	1.5
35–39	200,276	47,223	23.6	200,276	8,299	4.1	200,276	3,348	1.7
40–44	138,959	32,660	23.5	138,959	6,374	4.6	138,959	2,424	1.7
45–49	57,931	13,292	22.9	57,931	2,990	5.2	57,931	949	1.6
50–54	16,743	3,677	22.0	16,743	1,016	6.1	16,743	294	1.8
55+	5,291	1,052	19.9	5,291	297	5.6	5,291	59	1.1
Education level									
High school or less	1,669,758	181,175	10.9	1,669,758	26,555	1.6	1,669,758	14,823	0.9
Some college	268,029	46,228	17.2	268,029	7,408	2.8	268,029	3,439	1.3
Bachelor's degree	255,679	42,807	16.7	255,679	6,208	2.4	255,679	2,351	0.9
Advanced degree	164,100	31,290	19.1	164,100	5,630	3.4	164,100	1,220	0.7
Unknown	53,163	6,397	12.0	53,163	1,149	2.2	53,163	376	0.7
Rank									
Junior enlisted (E1–E4)	1,189,055	107,155	9.0	1,189,055	13,670	1.1	1,189,055	8,920	0.8
Senior enlisted (E5–E9)	886,275	137,572	15.5	886,275	23,660	2.7	886,275	10,596	1.2
Junior officer (O1–O4 [W1–W3])	192,876	35,099	18.2	192,876	4,290	2.2	192,876	1,623	0.8
Senior officer (O5–O10 [W4–W5])	142,523	28,071	19.7	142,523	5,330	3.7	142,523	1,070	0.8
Occupation									
Combat-specific	386,926	41,891	10.8	386,926	7,917	2.0	386,926	5,263	1.4
Armor/motor transport	78,871	8,164	10.4	78,871	1,447	1.8	78,871	939	1.2
Pilot/air crew	74,081	13,923	18.8	74,081	1,424	1.9	74,081	412	0.6
Repair/engineering	698,094	79,376	11.4	698,094	9,961	1.4	698,094	4,689	0.7
Communications/intelligence	520,104	73,481	14.1	520,104	11,356	2.2	520,104	5,699	1.1
Health care	196,942	39,575	20.1	196,942	8,023	4.1	196,942	2,192	1.1
Other	455,711	51,487	11.3	455,711	6,822	1.5	455,711	3,015	0.7

TABLE 3. Annual numbers and rates of chiropractic/osteopathic procedure-related healthcare visits, active component, U.S. Armed Forces, 2010–2015

	Total 2010–2015			2010			2011			2012		
	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members
Total	1,768,621	2,410,729	73.4	162,269	1,574,853	10.3	250,740	1,573,548	15.9	317,238	1,562,008	20.3
Service												
Army	814,821	961,009	84.8	73,280	626,149	11.7	118,080	624,738	18.9	144,762	616,901	23.5
Navy	234,274	553,490	42.3	21,072	356,903	5.9	33,349	356,627	9.4	42,583	355,583	12.0
Air Force	511,384	510,875	100.1	50,392	359,966	14.0	70,066	360,059	19.5	90,443	358,967	25.2
Marine Corps	208,142	385,355	54.0	17,525	231,835	7.6	29,245	232,124	12.6	39,450	230,557	17.1
Sex												
Male	1,334,825	2,035,092	65.6	122,114	1,345,379	9.1	188,258	1,343,100	14.0	240,048	1,331,358	18.0
Female	433,796	375,637	115.5	40,155	229,474	17.5	62,482	230,448	27.1	77,190	230,650	33.5
Race/ethnicity												
White, non-Hispanic	1,159,621	1,474,604	78.6	112,301	988,491	11.4	169,534	982,313	17.3	211,476	968,354	21.8
Black, non-Hispanic	242,718	386,256	62.8	20,232	251,299	8.1	32,470	250,537	13.0	42,822	248,936	17.2
Hispanic	185,768	299,338	62.1	14,377	172,705	8.3	24,310	175,518	13.9	32,023	176,924	18.1
American Indian/ Alaskan Native	19,554	26,386	74.1	1,979	18,204	10.9	2,882	17,946	16.1	3,593	17,776	20.2
Asian/Pacific Islander	72,687	90,408	80.4	5,682	63,372	9.0	9,431	63,346	14.9	12,301	63,393	19.4
Unknown race/ ethnicity	88,273	133,737	66.0	7,698	80,782	9.5	12,113	83,888	14.4	15,023	86,625	17.3
Age												
<20	17,758	252,264	7.0	1,799	122,485	1.5	2,674	116,468	2.3	2,821	121,776	2.3
20–24	287,652	948,716	30.3	25,992	531,554	4.9	43,883	519,270	8.5	53,943	503,550	10.7
25–29	382,815	517,826	73.9	32,947	370,698	8.9	56,211	380,312	14.8	71,890	378,256	19.0
30–34	328,311	272,723	120.4	26,692	218,527	12.2	42,985	226,267	19.0	59,314	231,432	25.6
35–39	332,331	200,276	165.9	31,765	170,685	18.6	46,253	166,183	27.8	57,626	163,762	35.2
40–44	261,532	138,959	188.2	26,191	104,091	25.2	36,675	107,345	34.2	45,680	106,498	42.9
45–49	114,413	57,931	197.5	11,830	41,785	28.3	15,955	42,261	37.8	18,699	41,260	45.3
50–54	33,761	16,743	201.6	3,821	11,577	33.0	4,623	11,875	38.9	5,573	11,891	46.9
55+	10,048	5,291	189.9	1,232	3,451	35.7	1,481	3,567	41.5	1,692	3,583	47.2
Education level												
High school or less	880,655	1,669,758	52.7	75,879	1,120,364	6.8	134,179	1,107,845	12.1	168,460	1,056,848	15.9
Some college	313,296	268,029	116.9	20,463	141,769	14.4	35,858	146,619	24.5	54,585	181,066	30.1
Bachelor's degree	288,218	255,679	112.7	30,684	168,318	18.2	39,427	171,854	22.9	47,331	176,116	26.9
Advanced degree	254,111	164,100	154.9	31,082	102,965	30.2	35,834	107,156	33.4	40,323	110,723	36.4
Unknown	32,341	53,163	60.8	4,161	41,437	10.0	5,442	40,074	13.6	6,539	37,255	17.6
Rank												
Junior enlisted (E1–E4)	457,627	1,189,055	38.5	38,379	716,259	5.4	68,771	713,218	9.6	88,854	704,680	12.6
Senior enlisted (E5–E9)	849,936	886,275	95.9	63,428	609,575	10.4	112,912	608,255	18.6	153,476	603,513	25.4
Junior officer (O1–O4 [W1–W3])	221,733	192,876	115.0	29,067	149,367	19.5	33,246	151,145	22.0	36,297	152,982	23.7
Senior officer (O5–O10 [W4–W5])	239,325	142,523	167.9	31,395	99,652	31.5	35,811	100,930	35.5	38,611	100,833	38.3
Occupation												
Combat-specific	217,720	386,926	56.3	19,752	246,088	8.0	31,777	245,265	13.0	41,135	241,657	17.0
Armor/motor transport	43,096	78,871	54.6	3,499	49,222	7.1	6,601	46,396	14.2	8,575	45,436	18.9
Pilot/air crew	102,323	74,081	138.1	11,790	55,449	21.3	16,424	56,142	29.3	17,225	57,126	30.2
Repair/engineering	439,828	698,094	63.0	38,423	451,825	8.5	61,292	448,905	13.7	79,950	441,069	18.1
Communications/ intelligence	439,992	520,104	84.6	38,553	341,071	11.3	61,629	345,079	17.9	77,781	343,607	22.6
Health care	237,898	196,942	120.8	21,947	129,483	16.9	32,106	131,474	24.4	41,217	133,884	30.8
Other	287,764	455,711	63.1	28,305	301,715	9.4	40,911	300,287	13.6	51,355	299,229	17.2

TABLE 3 (cont.). Annual numbers and rates of chiropractic/osteopathic procedure-related healthcare visits, active component, U.S. Armed Forces, 2010–2015

	2013			2014			2015		
	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members
Total	338,419	1,538,209	22.0	342,939	1,497,463	22.9	357,016	1,459,430	24.5
Service									
Army	155,798	602,984	25.8	158,388	574,574	27.6	164,513	553,338	29.7
Navy	43,737	352,834	12.4	44,592	354,006	12.6	48,941	356,642	13.7
Air Force	96,555	356,834	27.1	101,362	350,597	28.9	102,566	335,486	30.6
Marine Corps	42,329	225,557	18.8	38,597	218,286	17.7	40,996	213,964	19.2
Sex									
Male	256,357	1,307,945	19.6	258,192	1,269,405	20.3	269,856	1,232,611	21.9
Female	82,062	230,264	35.6	84,747	228,058	37.2	87,160	226,819	38.4
Race/ethnicity									
White, non-Hispanic	221,874	943,804	23.5	220,878	908,379	24.3	223,558	858,720	26.0
Black, non-Hispanic	46,343	247,767	18.7	48,240	243,873	19.8	52,611	239,872	21.9
Hispanic	35,184	177,849	19.8	37,474	177,945	21.1	42,400	200,043	21.2
American Indian/ Alaskan Native	3,977	17,210	23.1	3,577	16,741	21.4	3,546	15,222	23.3
Asian/Pacific Islander	14,381	63,731	22.6	15,050	63,974	23.5	15,842	58,030	27.3
Unknown race/ ethnicity	16,660	87,848	19.0	17,720	86,551	20.5	19,059	87,543	21.8
Age									
<20	3,041	131,016	2.3	3,603	124,625	2.9	3,820	128,620	3.0
20–24	53,745	489,234	11.0	53,717	477,375	11.3	56,372	467,337	12.1
25–29	74,184	364,371	20.4	72,257	350,109	20.6	75,326	335,218	22.5
30–34	65,212	232,124	28.1	65,385	230,345	28.4	68,723	224,023	30.7
35–39	62,942	160,604	39.2	64,986	158,277	41.1	68,759	154,128	44.6
40–44	50,258	104,209	48.2	51,370	99,713	51.5	51,358	93,890	54.7
45–49	20,907	41,199	50.7	23,272	41,289	56.4	23,750	40,734	58.3
50–54	6,372	11,924	53.4	6,435	12,272	52.4	6,937	12,160	57.0
55+	1,758	3,528	49.8	1,914	3,458	55.3	1,971	3,320	59.4
Education level									
High school or less	170,315	1,024,259	16.6	164,393	981,601	16.7	167,429	946,293	17.7
Some college	63,514	183,380	34.6	66,757	181,907	36.7	72,119	180,457	40.0
Bachelor's degree	52,741	180,317	29.2	57,074	182,573	31.3	60,961	182,843	33.3
Advanced degree	45,893	114,400	40.1	49,380	117,369	42.1	51,599	116,203	44.4
Unknown	5,956	35,853	16.6	5,335	34,013	15.7	4,908	33,634	14.6
Rank									
Junior enlisted (E1–E4)	88,585	688,661	12.9	85,349	659,967	12.9	87,689	649,060	13.5
Senior enlisted (E5–E9)	168,453	595,526	28.3	171,921	584,943	29.4	179,746	563,058	31.9
Junior officer (O1–O4 [W1–W3])	38,492	153,559	25.1	40,524	153,676	26.4	44,107	151,928	29.0
Senior officer (O5–O10 [W4–W5])	42,889	100,463	42.7	45,145	98,877	45.7	45,474	95,384	47.7
Occupation									
Combat-specific	43,256	229,182	18.9	39,019	220,831	17.7	42,781	213,041	20.1
Armor/motor transport	8,760	45,588	19.2	7,723	44,484	17.4	7,938	42,620	18.6
Pilot/air crew	17,874	55,795	32.0	19,011	55,367	34.3	19,999	53,570	37.3
Repair/engineering	84,423	447,592	18.9	86,212	443,056	19.5	89,528	430,910	20.8
Communications/ intelligence	83,972	335,027	25.1	87,608	327,385	26.8	90,449	319,109	28.3
Health care	45,028	134,534	33.5	47,422	133,379	35.6	50,178	129,302	38.8
Other	55,106	290,491	19.0	55,944	272,961	20.5	56,143	270,878	20.7

four times higher in 2015 (2.8 per 100/yr) than in 2010 (0.7 per 100/yr) **(Table 4)**. In general, rates of acupuncture-related encounters increased with age, military grade, and formal educational attainment. Also, rates were generally higher among Army members, women, and those in healthcare occupations compared to their respective counterparts.

Annual rates of encounters that included biofeedback procedures more than doubled from 2010 (0.3 per 100/yr) to 2015 (0.8 per 100/yr). In general, annual rates increased each year through 2014 but then decreased by approximately one-fourth in 2015. In contrast to the experiences with other CAM procedures, rates of biofeedback-related visits generally decreased in 2015—overall and in every demographic and military subgroup except Air Force members and the oldest (≥55 years) **(Table 5)**.

During the surveillance period, most active component members (85.9%) who had at least one CAM-related visit received at least one chiropractic/osteopathic manipulation procedure. Of service members with any CAM-related visits, 13.1% had at least one acupuncture-focused visit and 6.2% had at least one biofeedback-associated visit. Approximately two-thirds (66.1%) of all service members with any CAM procedure-related visits had two or more such visits. Among service members with two or more CAM visits, 10.9% were treated with both chiropractic/osteopathic manipulation and acupuncture and 4.2% with both chiropractic/osteopathic manipulation and biofeedback. Only 1.2% of service members with multiple CAM visits were treated with all three of the modalities assessed for this report **(data not shown)**.

A total of 240 installations had at least one CAM-related visit of any of the three types. The vast majority (97.5%) of these installations provided at least one chiropractic/osteopathic manipulation procedure during the period. More than three-quarters (78.8%) of the installations provided acupuncture procedures and a little more than one-third (35.8%) provided biofeedback procedures **(data not shown)**.

The top 20 installations with the most encounters that included chiropractic/osteopathic manipulations accounted for nearly half (45.9%) of all such encounters. The 20 installations with the most acupuncture-related encounters accounted for more than three-quarters (76.7%) of all such encounters; and the 20 installations with the most biofeedback procedure-related encounters accounted for 88.5% of all such encounters **(Table 6)**.

Army installations accounted for majorities of the 20 installations with the most visits for each CAM modality (14 chiropractic/osteopathic manipulation; 11 acupuncture [includes one multi-service]; 16 biofeedback [includes one multi-service]) **(Table 6)**. Nine installations were among the top 20 installations in regard to visits for all three CAM modalities; and Fort Hood, TX, and Camp Pendleton, CA, were among the top 10 installations in regard to visits for all three modalities. Fort Hood and Camp Pendleton accounted for 3.8% and 3.1% of all CAM visits, respectively, while Joint Base Lewis-McChord, WA, and Joint Base San Antonio, TX, each accounted for 3.6% of all CAM encounters **(Table 6)**.

During the period overall, more than half (56.2%) of all CAM-related visits had primary (first-listed) diagnoses of "other and unspecified disorders of the back" (32.1%) or "nonallopathic lesions [of the musculoskeletal system] not elsewhere classified" (24.1%) **(data not shown)**. The former diagnosis was the most frequent during visits that included chiropractic/osteopathic manipulation (33.8%) or acupuncture procedures (25.8%) and the eighth (3.5%) most frequent during biofeedback-related visits **(Figures 1–3)**. The majority of these back disorders had specific diagnostic codes for lumbago **(data not shown)**.

The diagnosis of "non-allopathic lesions not elsewhere classified" was the second most frequent during chiropractic/osteopathic manipulation-related visits (27.3%) and the 16th most frequent during visits that included acupuncture procedures (1.2%) **(Figure 1; data not shown)**. Most of these diagnoses had specific codes for "somatic dysfunction" of either the lumbar or thoracic region **(data not shown)**. The second most frequent (10.4%) primary diagnosis during acupuncture-related visits was "acute and chronic pain" **(Figure 2)**. "Adjustment reaction" was the third most frequent (7.4%) primary diagnosis during acupuncture-related visits and the second most frequent diagnosis during encounters that included biofeedback procedures (17.1%) **(Figures 2 and 3)**.

EDITORIAL COMMENT

This report provides an overview of CAM procedures used during healthcare encounters among active component service members from 2010 to 2015. Overall, about one of every seven (14.9%) individuals who served in the active component during the surveillance period had at least one healthcare encounter that included one of the CAM procedures of interest for this report.

Chiropractic/osteopathic manipulation procedures represented the majority (88.0%) of visits that included any of the CAM procedures of interest. During the surveillance period, 12.8% of all active component members had at least one ambulatory visit that included a chiropractic/osteopathic manipulation procedure. Survey-based prevalence estimates for use of chiropractic procedures using military samples range from 6.2% to 8.6%.[2,4,14] The age-adjusted prevalence estimate for use of chiropractic/osteopathic manipulation among U.S. adults from the 2012 National Health Interview Survey (NHIS) was 8.4%.[1]

In the current study, approximately 2% of all active component members had at least one medical visit that included acupuncture. This estimate falls within the range of survey-based prevalence estimates (1.5% to 2.4%)[2,4,14] for use of acupuncture procedures among military samples. The NHIS 2012 survey yielded an age-adjusted prevalence estimate of 1.5% for use of acupuncture.[1]

In this analysis, 0.9% of all active component service members had at least one biofeedback procedure-related visit during the surveillance period. The estimate is slightly higher than those from survey-based studies using military service member samples which range from 0.6% to 0.7%.[2,4,14] The age-adjusted prevalence estimate for use of biofeedback procedures from the NHIS 2012 survey was 0.1%.[1]

TABLE 4. Annual numbers and rates of acupuncture procedure-related healthcare visits, active component, U.S. Armed Forces, 2010–2015

	Total 2010–2015			2010			2011			2012		
	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members
Total ACU	175,679	2,410,729	7.3	10,471	1,574,853	0.7	17,930	1,573,548	1.1	30,002	1,562,008	1.9
Service												
Army	102,842	961,009	10.7	6,661	626,149	1.1	11,261	624,738	1.8	18,117	616,901	2.9
Navy	26,119	553,490	4.7	1,305	356,903	0.4	2,380	356,627	0.7	4,328	355,583	1.2
Air Force	26,914	510,875	5.3	2,055	359,966	0.6	2,608	360,059	0.7	4,170	358,967	1.2
Marine Corps	19,804	385,355	5.1	450	231,835	0.7	1,681	232,124	0.7	3,387	230,557	1.5
Sex												
Male	128,584	2,035,092	6.3	7,526	1,345,379	0.6	13,353	1,343,100	1.0	22,229	1,331,358	1.7
Female	47,095	375,637	12.5	2,945	229,474	1.3	4,577	230,448	2.0	7,773	230,650	3.4
Race/ethnicity												
White, non-Hispanic	106,494	1,474,604	7.2	6,752	988,491	0.7	11,262	982,313	1.1	18,918	968,354	2.0
Black, non-Hispanic	26,053	386,256	6.7	1,293	251,299	0.5	2,313	250,537	0.9	4,004	248,936	1.6
Hispanic	22,984	299,338	7.7	1,320	172,705	0.8	2,388	175,518	1.4	3,802	176,924	2.1
American Indian/ Alaskan Native	2,280	26,386	8.6	79	18,204	0.4	257	17,946	1.4	386	17,776	2.2
Asian/Pacific Islander	8,651	90,408	9.6	490	63,372	0.8	815	63,346	1.3	1,470	63,393	2.3
Unknown race/ ethnicity	9,217	133,737	6.9	537	80,782	0.7	895	83,888	1.1	1,422	86,625	1.6
Age												
<20	959	252,264	0.4	29	122,485	0.0	95	116,468	0.1	219	121,776	0.2
20–24	23,079	948,716	2.4	1,169	531,554	0.2	2,588	519,270	0.5	4,564	503,550	0.9
25–29	37,901	517,826	7.3	2,108	370,698	0.6	3,983	380,312	1.0	7,466	378,256	2.0
30–34	34,088	272,723	12.5	1,773	218,527	0.8	3,418	226,267	1.5	5,821	231,432	2.5
35–39	32,354	200,276	16.2	2,092	170,685	1.2	2,971	166,183	1.8	5,055	163,762	3.1
40–44	27,598	138,959	19.9	1,863	104,091	1.8	2,767	107,345	2.6	4,093	106,498	3.8
45–49	14,037	57,931	24.2	954	41,785	2.3	1,448	42,261	3.4	1,975	41,260	4.8
50–54	4,286	16,743	25.6	314	11,577	2.7	480	11,875	4.0	643	11,891	5.4
55+	1,377	5,291	26.0	169	3,451	4.9	180	3,567	5.0	166	3,583	4.6
Education level												
High school or less	95,521	1,669,758	5.7	5,059	1,120,364	0.5	10,803	1,107,845	1.0	17,624	1,056,848	1.7
Some college	29,399	268,029	11.0	1,152	141,769	0.8	1,774	146,619	1.2	4,575	181,066	2.5
Bachelor's degree	24,950	255,679	9.8	1,591	168,318	0.9	2,298	171,854	1.3	3,829	176,116	2.2
Advanced degree	21,932	164,100	13.4	2,253	102,965	2.2	2,516	107,156	2.3	3,299	110,723	3.0
Unknown	3,877	53,163	7.3	416	41,437	1.0	539	40,074	1.3	675	37,255	1.8
Rank												
Junior enlisted (E1–E4)	47,126	1,189,055	4.0	2,297	716,259	0.3	5,250	713,218	0.7	9,820	704,680	1.4
Senior enlisted (E5–E9)	91,993	886,275	10.4	4,534	609,575	0.7	8,457	608,255	1.4	14,517	603,513	2.4
Junior officer (O1–O4 [W1–W3])	15,909	192,876	8.2	1,385	149,367	0.9	1,708	151,145	1.1	2,565	152,982	1.7
Senior officer (O5–O10 [W4–W5])	20,651	142,523	14.5	2,255	99,652	2.3	2,515	100,930	2.5	3,100	100,833	3.1
Occupation												
Combat-specific	31,133	386,926	8.0	1,753	246,088	0.7	3,379	245,265	1.4	5,810	241,657	2.4
Armor/motor transport	5,877	78,871	7.5	224	49,222	0.5	741	46,396	1.6	1,226	45,436	2.7
Pilot/air crew	4,019	74,081	5.4	504	55,449	0.9	564	56,142	1.0	685	57,126	1.2
Repair/engineering	35,914	698,094	5.1	2,088	451,825	0.5	3,492	448,905	0.8	6,018	441,069	1.4
Communications/ intelligence	45,034	520,104	8.7	2,171	341,071	0.6	3,916	345,079	1.1	7,250	343,607	2.1
Health care	28,233	196,942	14.3	2,055	129,483	1.6	2,814	131,474	2.1	4,704	133,884	3.5
Other	25,469	455,711	5.6	1,676	301,715	0.6	3,024	300,287	1.0	4,309	299,229	1.4

TABLE 4 (cont.). Annual numbers and rates of acupuncture procedure-related healthcare visits, active component, U.S. Armed Forces, 2010–2015

	2013			2014			2015		
	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members
Total ACU	37,147	1,538,209	2.4	38,850	1,497,463	2.6	41,279	1,459,430	2.8
Service									
Army	22,467	602,984	3.7	22,293	574,574	3.9	22,043	553,338	4.0
Navy	5,272	352,834	1.5	6,246	354,006	1.8	6,588	356,642	1.8
Air Force	5,848	356,834	1.6	5,655	350,597	1.6	6,578	335,486	2.0
Marine Corps	3,560	225,557	1.6	4,656	218,286	2.1	6,070	213,964	2.8
Sex									
Male	26,929	1,307,945	2.1	28,566	1,269,405	2.3	29,981	1,232,611	2.4
Female	10,218	230,264	4.4	10,284	228,058	4.5	11,298	226,819	5.0
Race/ethnicity									
White, non-Hispanic	22,461	943,804	2.4	23,007	908,379	2.5	24,094	858,720	2.8
Black, non-Hispanic	5,413	247,767	2.2	6,221	243,873	2.6	6,809	239,872	2.8
Hispanic	4,896	177,849	2.8	5,083	177,945	2.9	5,495	200,043	2.7
American Indian/ Alaskan Native	459	17,210	2.7	552	16,741	3.3	547	15,222	3.6
Asian/Pacific Islander	1,976	63,731	3.1	1,889	63,974	3.0	2,011	58,030	3.5
Unknown race/ ethnicity	1,942	87,848	2.2	2,098	86,551	2.4	2,323	87,543	2.7
Age									
<20	148	131,016	0.1	179	124,625	0.1	289	128,620	0.2
20–24	4,422	489,234	0.9	5,027	477,375	1.1	5,309	467,337	1.1
25–29	8,059	364,371	2.2	7,978	350,109	2.3	8,307	335,218	2.5
30–34	7,511	232,124	3.2	7,600	230,345	3.3	7,965	224,023	3.6
35–39	6,998	160,604	4.4	7,290	158,277	4.6	7,948	154,128	5.2
40–44	5,950	104,209	5.7	6,307	99,713	6.3	6,618	93,890	7.0
45–49	2,892	41,199	7.0	3,355	41,289	8.1	3,413	40,734	8.4
50–54	926	11,924	7.8	854	12,272	7.0	1,069	12,160	8.8
55+	241	3,528	6.8	260	3,458	7.5	361	3,320	10.9
Education level									
High school or less	19,835	1,024,259	1.9	20,695	981,601	2.1	21,505	946,293	2.3
Some college	6,742	183,380	3.7	7,174	181,907	3.9	7,982	180,457	4.4
Bachelor's degree	5,221	180,317	2.9	5,610	182,573	3.1	6,401	182,843	3.5
Advanced degree	4,608	114,400	4.0	4,639	117,369	4.0	4,617	116,203	4.0
Unknown	741	35,853	2.1	732	34,013	2.2	774	33,634	2.3
Rank									
Junior enlisted (E1–E4)	9,807	688,661	1.4	10,063	659,967	1.5	9,889	649,060	1.5
Senior enlisted (E5–E9)	19,883	595,526	3.3	21,139	584,943	3.6	23,463	563,058	4.2
Junior officer (O1–O4 [W1–W3])	3,442	153,559	2.2	3,221	153,676	2.1	3,588	151,928	2.4
Senior officer (O5–O10 [W4–W5])	4,015	100,463	4.0	4,427	98,877	4.5	4,339	95,384	4.5
Occupation									
Combat-specific	6,103	229,182	2.7	7,005	220,831	3.2	7,083	213,041	3.3
Armor/motor transport	1,165	45,588	2.6	1,323	44,484	3.0	1,198	42,620	2.8
Pilot/air crew	736	55,795	1.3	708	55,367	1.3	822	53,570	1.5
Repair/engineering	7,415	447,592	1.7	7,631	443,056	1.7	9,270	430,910	2.2
Communications/ intelligence	10,017	335,027	3.0	10,584	327,385	3.2	11,096	319,109	3.5
Health care	6,098	134,534	4.5	6,125	133,379	4.6	6,437	129,302	5.0
Other	5,613	290,491	1.9	5,474	272,961	2.0	5,373	270,878	2.0

TABLE 5. Annual numbers and rates of biofeedback-related healthcare visits, active component, U.S. Armed Forces, 2010–2015

	Total 2010–2015			2010			2011			2012		
	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members
Total BIO	66,149	2,410,729	2.7	5,301	1,574,853	0.3	8,540	1,573,548	0.5	9,844	1,562,008	0.63
Service												
Army	48,054	961,009	5.0	3,844	626,149	0.6	6,375	624,738	1.0	6,572	616,901	1.1
Navy	2,620	553,490	0.5	195	356,903	0.1	371	356,627	0.1	412	355,583	0.1
Air Force	4,466	510,875	0.9	674	359,966	0.2	675	360,059	0.2	908	358,967	0.3
Marine Corps	11,009	385,355	2.9	588	231,835	0.3	1,119	232,124	0.5	1,952	230,557	0.8
Sex												
Male	55,119	2,035,092	2.7	4,523	1,345,379	0.3	7,046	1,343,100	0.5	8,126	1,331,358	0.6
Female	11,030	375,637	2.9	778	229,474	0.3	1,494	230,448	0.7	1,718	230,650	0.7
Race/ethnicity												
White, non-Hispanic	39,871	1,474,604	2.7	3,261	988,491	0.3	5,211	982,313	0.5	6,355	968,354	0.7
Black, non-Hispanic	12,342	386,256	3.2	879	251,299	0.4	1,617	250,537	0.7	1,656	248,936	0.7
Hispanic	9,035	299,338	3.0	784	172,705	0.5	1,091	175,518	0.7	1,072	176,924	0.6
American Indian/ Alaskan Native	505	26,386	1.9	57	18,204	0.3	62	17,946	0.4	83	17,776	0.5
Asian/Pacific Islander	2,246	90,408	2.5	169	63,372	0.3	265	63,346	0.4	337	63,393	0.5
Unknown race/ ethnicity	2,150	133,737	1.6	151	80,782	0.2	294	83,888	0.4	341	86,625	0.4
Age												
<20	970	252,264	0.4	48	122,485	0.0	132	116,468	0.1	166	121,776	0.1
20–24	12,934	948,716	1.4	1,004	531,554	0.2	1,886	519,270	0.4	2,196	503,550	0.4
25–29	17,086	517,826	3.3	1,405	370,698	0.4	2,448	380,312	0.6	2,943	378,256	0.8
30–34	12,905	272,723	4.7	1,005	218,527	0.5	1,710	226,267	0.8	1,642	231,432	0.7
35–39	10,836	200,276	5.4	963	170,685	0.6	1,307	166,183	0.8	1,572	163,762	1.0
40–44	7,505	138,959	5.4	588	104,091	0.6	697	107,345	0.7	935	106,498	0.9
45–49	2,935	57,931	5.1	218	41,785	0.5	271	42,261	0.7	284	41,260	0.7
50–54	846	16,743	5.1	58	11,577	0.5	80	11,875	0.7	92	11,891	0.8
55+	132	5,291	2.5	12	3,451	0.4	9	3,567	0.3	14	3,583	0.4
Education level												
High school or less	46,257	1,669,758	2.8	3,742	1,120,364	0.3	6,494	1,107,845	0.6	7,466	1,056,848	0.7
Some college	9,941	268,029	3.7	666	141,769	0.5	826	146,619	0.6	1,323	181,066	0.7
Bachelor's degree	6,073	255,679	2.4	520	168,318	0.3	701	171,854	0.4	627	176,116	0.4
Advanced degree	2,819	164,100	1.7	263	102,965	0.3	302	107,156	0.3	300	110,723	0.3
Unknown	1,059	53,163	2.0	110	41,437	0.3	217	40,074	0.5	128	37,255	0.3
Rank												
Junior enlisted (E1–E4)	24,067	1,189,055	2.0	1,877	716,259	0.3	3,627	713,218	0.5	4,269	704,680	0.6
Senior enlisted (E5–E9)	35,431	886,275	4.0	2,648	609,575	0.4	4,081	608,255	0.7	4,957	603,513	0.8
Junior officer (O1–O4 [W1–W3])	4,154	192,876	2.2	467	149,367	0.3	542	151,145	0.4	340	152,982	0.2
Senior officer (O5–O10 [W4–W5])	2,497	142,523	1.8	309	99,652	0.3	290	100,930	0.3	278	100,833	0.3
Occupation												
Combat-specific	19,885	386,926	5.1	1,402	246,088	0.6	2,217	245,265	1.0	2,931	241,657	1.2
Armor/motor transport	3,156	78,871	4.0	206	49,222	0.4	425	46,396	1.0	537	45,436	1.2
Pilot/air crew	1,129	74,081	1.5	205	55,449	0.4	237	56,142	0.4	153	57,126	0.3
Repair/engineering	13,314	698,094	1.9	1,258	451,825	0.3	1,769	448,905	0.4	1,952	441,069	0.4
Communications/ intelligence	14,532	520,104	2.8	1,103	341,071	0.3	1,953	345,079	0.6	2,155	343,607	0.6
Health care	5,943	196,942	3.0	518	129,483	0.4	853	131,474	0.7	949	133,884	0.7
Other	8,190	455,711	1.8	609	301,715	0.2	1,086	300,287	0.4	1,167	299,229	0.4

TABLE 5 (cont.). Annual numbers and rates of biofeedback-related healthcare visits, active component, U.S. Armed Forces, 2010–2015

	2013			2014			2015		
	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members	No. of visits	No. of service members	No. of visits per 100 service members
Total BIO	13,983	1,538,209	1.0	16,280	1,497,463	1.1	12,201	1,459,430	0.8
Service									
Army	10,505	602,984	1.7	12,386	574,574	2.2	8,372	553,338	1.5
Navy	548	352,834	0.2	661	354,006	0.2	433	356,642	0.1
Air Force	533	356,834	0.1	694	350,597	0.2	982	335,486	0.3
Marine Corps	2,397	225,557	1.1	2,539	218,286	1.2	2,414	213,964	1.1
Sex									
Male	11,988	1,307,945	0.9	13,445	1,269,405	1.1	9,991	1,232,611	0.8
Female	1,995	230,264	0.9	2,835	228,058	1.2	2,210	226,819	1.0
Race/ethnicity									
White, non-Hispanic	8,689	943,804	0.9	9,285	908,379	1.0	7,070	858,720	0.9
Black, non-Hispanic	2,391	247,767	1.0	3,281	243,873	1.3	2,518	239,872	1.1
Hispanic	1,934	177,849	1.1	2,424	177,945	1.4	1,730	200,043	0.9
American Indian/ Alaskan Native	83	17,210	0.5	136	16,741	0.8	84	15,222	0.6
Asian/Pacific Islander	450	63,731	0.7	619	63,974	1.0	406	58,030	0.7
Unknown race/ ethnicity	436	87,848	0.5	535	86,551	0.6	393	87,543	0.5
Age									
<20	147	131,016	0.1	224	124,625	0.2	253	128,620	0.2
20–24	2,727	489,234	0.6	2,884	477,375	0.6	2,237	467,337	0.5
25–29	3,849	364,371	1.1	3,863	350,109	1.1	2,578	335,218	0.8
30–34	2,813	232,124	1.2	3,218	230,345	1.4	2,517	224,023	1.1
35–39	2,168	160,604	1.3	2,611	158,277	1.6	2,215	154,128	1.4
40–44	1,573	104,209	1.5	2,240	99,713	2.2	1,472	93,890	1.6
45–49	538	41,199	1.3	930	41,289	2.3	694	40,734	1.7
50–54	159	11,924	1.3	274	12,272	2.2	183	12,160	1.5
55+	9	3,528	0.3	36	3,458	1.0	52	3,320	1.6
Education level									
High school or less	9,926	1,024,259	1.0	10,776	981,601	1.1	7,853	946,293	0.8
Some college	2,165	183,380	1.2	2,766	181,907	1.5	2,195	180,457	1.2
Bachelor's degree	1,168	180,317	0.6	1,722	182,573	0.9	1,335	182,843	0.7
Advanced degree	513	114,400	0.4	769	117,369	0.7	672	116,203	0.6
Unknown	211	35,853	0.6	247	34,013	0.7	146	33,634	0.4
Rank									
Junior enlisted (E1–E4)	5,021	688,661	0.7	5,409	659,967	0.8	3,864	649,060	0.6
Senior enlisted (E5–E9)	7,729	595,526	1.3	9,057	584,943	1.5	6,959	563,058	1.2
Junior officer (O1–O4 [W1–W3])	769	153,559	0.5	1,184	153,676	0.8	852	151,928	0.6
Senior officer (O5–O10 [W4–W5])	464	100,463	0.5	630	98,877	0.6	526	95,384	0.6
Occupation									
Combat-specific	4,960	229,182	2.2	4,935	220,831	2.2	3,440	213,041	1.6
Armor/motor transport	721	45,588	1.6	788	44,484	1.8	479	42,620	1.1
Pilot/air crew	157	55,795	0.3	195	55,367	0.4	182	53,570	0.3
Repair/engineering	2,438	447,592	0.5	3,218	443,056	0.7	2,679	430,910	0.6
Communications/ intelligence	2,738	335,027	0.8	3,691	327,385	1.1	2,892	319,109	0.9
Health care	1,235	134,534	0.9	1,453	133,379	1.1	935	129,302	0.7
Other	1,734	290,491	0.6	2,000	272,961	0.7	1,594	270,878	0.6

TABLE 6. Numbers of healthcare encounters that included CAM procedures by installation and CAM modality, active component, U.S. Armed Forces, 2010–2015

Chiropractic/osteopathic manipulation			Acupuncture			Biofeedback		
Installation	No.	% total	Installation	No.	% total	Installation	No.	% total
Joint (AF) San Antonio LAF-RAF-FSH, TX	67,866	3.8	Fort Hood, TX	21,783	12.4	Fort Hood, TX	10,028	15.2
Joint (AF) Base Lewis-McChord, WA	63,931	3.6	Fort Shafter, HI	13,199	7.5	Fort Benning, GA	6,910	10.4
Fort Riley, KS	52,881	3.0	Fort Bliss, TX	10,472	6.0	Camp Lejeune, NC	6,824	10.3
Fort Bragg, NC	50,520	2.9	Fort Gordon, GA	9,508	5.4	Fort Sill, OK	5,658	8.6
Camp Pendleton, CA	50,351	2.8	Landstuhl, Germany	9,327	5.3	Fort Bliss, TX	4,963	7.5
Fort Hood, TX	44,674	2.5	Camp Pendleton, CA	7,861	4.5	Camp Pendleton, CA	4,508	6.8
Fort Rucker, AL	42,530	2.4	Bethesda, MD	7,107	4.0	Hunter Army Airfield, GA	2,038	3.1
Camp Lejeune, NC	42,357	2.4	Joint (AF) Base Lewis-McChord, WA	7,010	4.0	Fort Gordon, GA	1,996	3.0
Fort Carson, CO	39,037	2.2	Fort Carson, CO	6,350	3.6	Little Rock AFB, AR	1,991	3.0
Fort Campbell, KY	37,265	2.1	Fort Bragg, NC	5,874	3.3	Fort Campbell, KY	1,984	3.0
Fort Stewart, GA	36,747	2.1	Joint (NF) Andrews Naval Air Facility, MD	5,592	3.2	Schofield Barracks, HI	1,788	2.7
Schofield Barracks, HI	36,736	2.1	Camp Lejeune, NC	4,750	2.7	Joint (AF) Base Lewis-McChord, WA	1,492	2.3
Fort Drum, NY	33,516	1.9	San Diego, CA	4,467	2.5	Fort Rucker, AL	1,264	1.9
San Diego, CA	32,793	1.9	Fort Belvoir, VA	4,366	2.5	Landstuhl, Germany	1,254	1.9
Portsmouth, VA	31,802	1.8	Fort Campbell, KY	3,940	2.2	Fort Meade, MD	1,235	1.9
Fort Gordon, GA	31,371	1.8	Portsmouth, VA	3,053	1.7	Joint (AF) BSE Elmendorf-Richardson, AK	1,167	1.8
MacDill AFB, FL	31,022	1.8	Joint (AF) San Antonio LAF-RAF-FSH, TX	2,916	1.7	Fort Polk, LA	1,036	1.6
Fort Bliss, TX	29,957	1.7	Okinawa, Japan	2,435	1.4	Bethesda, MD	858	1.3
Landstuhl, Germany	28,605	1.6	Joint (NF) Base Pearl Harbor-Hickam, HI	2,446	1.4	Joint (AF) San Antonio LAF-RAF-FSH, TX	844	1.3
Kirkland AFB, NM	28,241	1.6	Nellis AFB, NV	2,329	1.3	Groton, CT	711	1.1
All other locations	956,419	54.1	All other locations	40,894	23.3	All other locations	7,600	11.5
Total	1,768,621	100.0	Total	175,679	100.0	Total	66,149	100.0

Many of the demographic characteristics associated with chiropractic/osteopathic manipulation-related visits in this analysis correspond to those previously identified as correlates of higher use of chiropractic procedures among military personnel, including female sex, white non-Hispanic race/ethnicity, older age, and higher formal educational attainment.[4] Other studies of CAM use, among the general and military populations, have not assessed the uses of acupuncture and

FIGURE 1. Percentage distribution of primary (first-listed) diagnoses among healthcare encounters that included chiropractic/osteopathic manipulation, active component, U.S. Armed Forces, 2010–2015

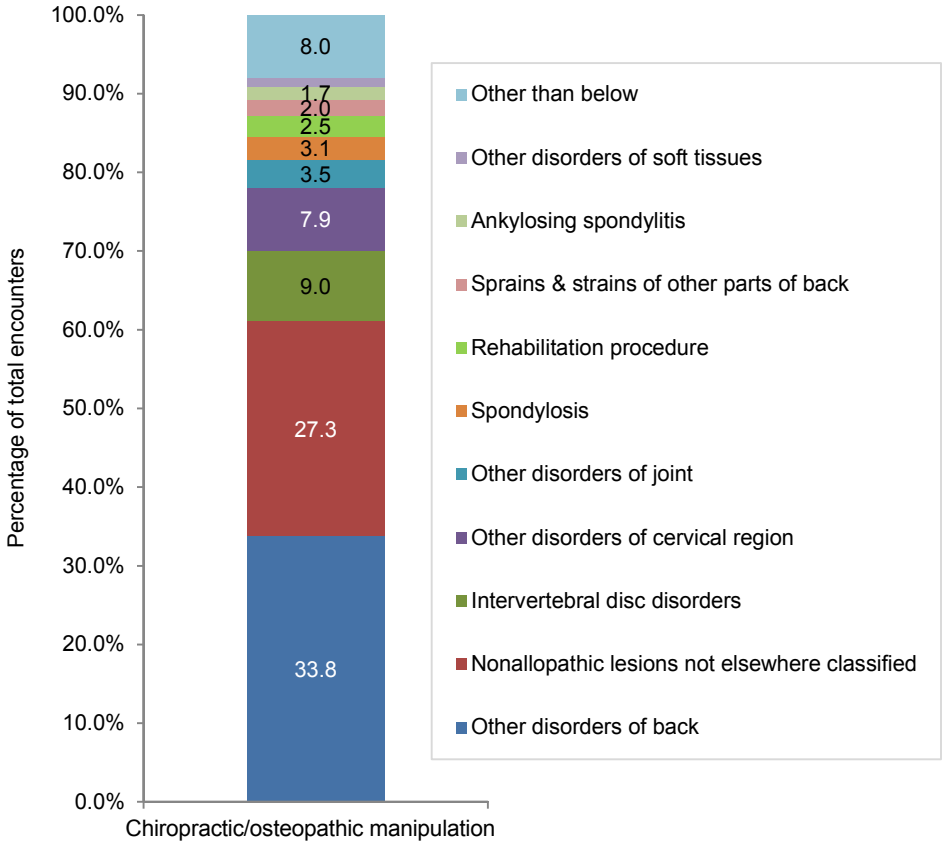
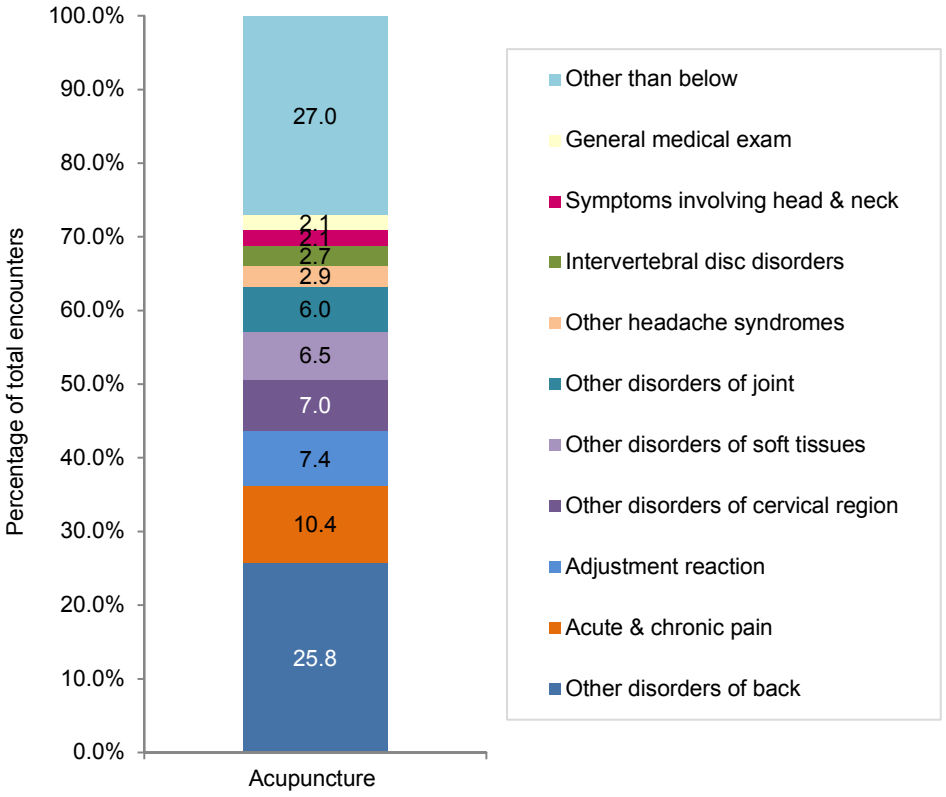


FIGURE 2. Percentage distribution of primary (first-listed) diagnoses among healthcare encounters that included acupuncture, active component, U.S. Armed Forces, 2010–2015



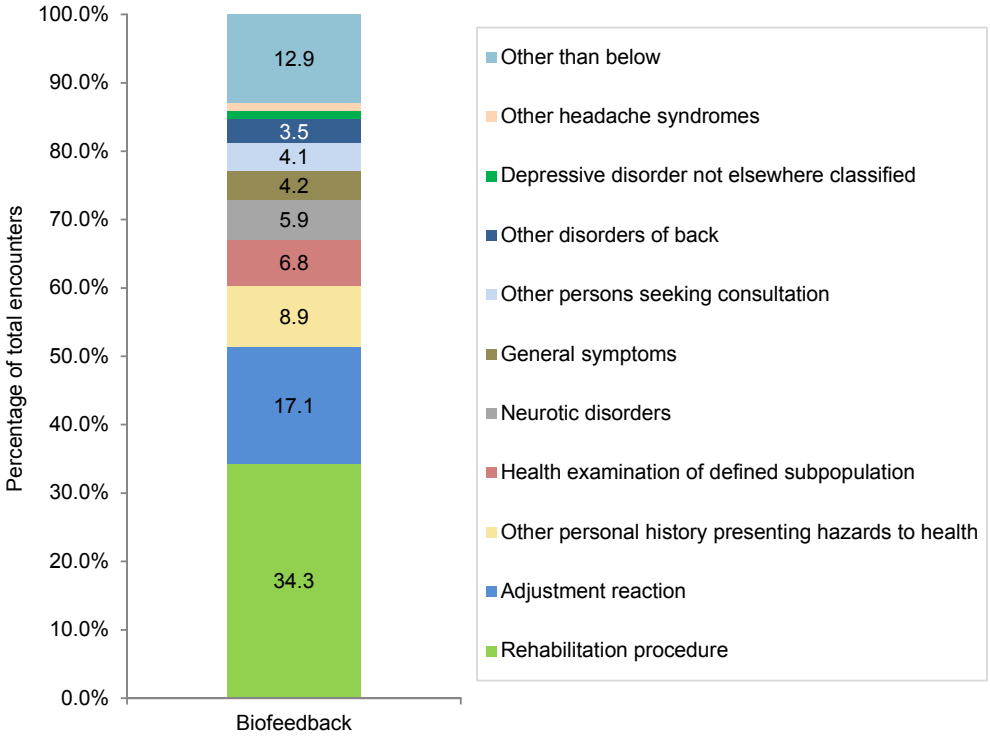
biofeedback separately in relation to demographic characteristics.

The vast majority (97.5%) of military installations included in this analysis provided chiropractic/osteopathic manipulation procedures; more than three-quarters (78.8%) of the installations provided acupuncture procedures; and, a little more than one-third (35.8%) provided biofeedback procedures. This distribution of CAM modalities is roughly similar to that reported for the 120 MTFs offering CAM programs in 2012.[15]

The most frequent medical condition for which chiropractic/osteopathic manipulation and acupuncture were used was "other and unspecified disorders of the back." Back disorders are consistently leading causes of medical encounters, lost duty time, and medical disability discharges among U.S. military members.[16,17] In 2015, this category (which includes diagnoses such as lumbago and unspecified backache) was the primary diagnosis in more than a million medical encounters, affecting 222,787 service members.[16] Conditions of the musculoskeletal system and connective tissue accounted for the vast majority (90.1%) of chiropractic/osteopathic manipulation-associated diagnoses. To clarify the observation about the frequency of diagnoses of "somatic dysfunction," the following detail is provided. Somatic dysfunction is an osteopathic concept that is defined as "impaired or altered function of related components of the somatic (body framework) system: skeletal, arthrodial, and myofascial structures, and related vascular, lymphatic, and neural elements."[18] Diagnostic criteria for this condition include asymmetry, restriction of motion, tissue texture abnormality, and tenderness—any of which are required for the diagnosis.[18] The second and third most frequent primary diagnoses during acupuncture-related visits were "acute and chronic pain" and "adjustment reaction," respectively. Musculoskeletal and connective tissue conditions accounted for approximately half (53.9%) of all primary diagnoses during acupuncture-related visits.

"Adjustment reaction" was the second most frequent diagnosis during encounters that included biofeedback procedures. In 2015, adjustment reaction (which includes

FIGURE 3. Percentage distribution of primary (first-listed) diagnoses among healthcare encounters that included biofeedback, active component, U.S. Armed Forces, 2010–2015



post-traumatic stress disorder) was among the 10 most frequently reported illness-specific diagnoses during ambulatory encounters for both men and women.[16] Other frequent diagnoses associated with biofeedback-related visits included a mix of rehabilitation procedures, some mental health conditions (e.g., neurotic disorders, depressive disorders not elsewhere classified, specific nonpsychotic mental disorders following organic brain damage), and supplemental classification codes/factors not indicative of a current illness or injury but associated with health status and contact with health services.

There are significant limitations that should be considered when interpreting the results of this analysis. The results presented here are likely to underestimate utilization of the CAM approaches of interest for several reasons. First, because of the reliance on CPT codes, the analysis was restricted to direct care encounters at U.S. military medical facilities. Records of purchased (outsourced) care that entailed the use of CAM procedures were not available for this analysis.

Another limitation of this report's findings applies specifically to the biofeedback results. Biofeedback procedures can be self-administered or accessed outside of conventional medical treatment facilities. Under those circumstances, such practices are not documented in medical records and thus could not be included in the analysis. Also, there are two biofeedback codes for mental health providers, 90875 and 90876, that refer to sessions that combine biofeedback with a form of talk therapy or counseling. Because these codes were not included, treated mental health conditions are likely underrepresented for this modality.

Another source of underestimation of the use of CAM procedures in this analysis is the inability to quantify CAM use during combat-related deployments despite known usage of at least acupuncture in this setting.[19,20] Because some care is provided by medical personnel in remote or austere locations, not all medical encounters in theaters of operation are captured in TMDS. In addition, we ascertained CAM usage through CPT codes in medical encounters; although TMDS can capture CPT codes if entered, very few medical encounters had CPT codes entered. It is likely that acupuncture and other CAM procedures are not documented in theater using CPT codes. As a result, our method of ascertainment was insufficient to capture the use of these modalities in theater.

In summary, the findings of this analysis document that chiropractic/osteopathic manipulation, acupuncture, and biofeedback are used frequently among active component U.S. service members. Also, the uses of these CAM approaches have increased generally, and in some situations markedly, since 2010. The topic of CAM use among service members is of increasing importance as consensus grows that these approaches have some utility as adjunct treatments for psychological and other health conditions among the military.[21–27] Repeated deployments and the aging of service members result in increasing prevalences of musculoskeletal problems, traumatic brain injury, and psychological health conditions.[16] Because relatively few studies have focused on the reasons for CAM use, our understanding of why military personnel are using CAM and the role these procedures play in their health care is limited. Research that employs administrative data in conjunction with survey data could address this knowledge gap and also potentially help the Military Health System monitor the need for workforce training and programmatic planning.

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Incident Diagnoses of Cancers in the Active Component and Cancer-related Deaths in the Active and Reserve Components, U.S. Armed Forces, 2005–2014

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Cancer is the second leading cause of death in the U.S., surpassed only by heart disease. It is estimated that approximately one of every four deaths in the U.S. is due to cancer. Between 2005 and 2014 among active component service members in the U.S. military, crude incidence rates of most cancer diagnoses have remained relatively stable. During this period, 8,973 active component members were diagnosed with at least one of the cancers of interest and no specific increasing or decreasing trends were evident. Cancers accounted for 1,054 deaths of service members on active duty during the 10-year surveillance period; this included 727 service members in the active component and 327 in the reserve component.

Recognizing cancer as a major public health problem for the U.S., in his State of the Union address on January 12, 2016, President Barack Obama announced the establishment of a new "Cancer Moonshot," which aims to double the rate of cancer research and treatment.[1] Integral to the tracking of these efforts will be the surveillance of cancer cases and deaths to monitor trends. Nationwide, deaths from all cancers combined have declined since the early 1990s and deaths from specific types of cancer, including common cancers of the lung, colon, breast, and prostate, have also declined.[2] Despite these improvements, cancer still remains the second leading cause of death in the U.S. and recent research has noted increases in the incidence of some cancers such as kidney, pancreas, liver, and melanoma of the skin.[3]

In previous years, the *MSMR* reported incidence rates and enumerated cancer-related deaths from malignant melanoma and nine other selected cancer diagnoses, including colorectal, lung/bronchus, brain/other central nervous system, non-Hodgkin lymphoma, leukemia, female breast, cervix, prostate, and testis.[4,5] For these cancers, the rates in the active component of the U.S. military during 2000–2011 had remained relatively stable. The analysis for this report expands on previous work to include in situ cancers of the colon/rectum, lung/bronchus, female breast, and prostate, as well as additional cancer sites including the bladder, bladder in situ, kidney, liver, pancreas, stomach, and ovary. The report summarizes counts, rates, and trends of incident diagnoses of melanoma and these selected cancers in the active component and enumerates cancer-related deaths among active and reserve component military members for the 10-year period from 2005 through 2014.

METHODS

The surveillance period was 1 January 2005 through 31 December 2014. The surveillance population included all individuals who served in the active component of the U.S. Armed Forces at any time during the surveillance period. For deaths attributed to cancer, the surveillance population included all individuals who served in the active or reserve components of the U.S. Army, Navy, Air Force, Marine Corps, or Coast Guard during the surveillance period. All data used to determine incident cancer cases were derived from records routinely maintained in the Defense Medical Surveillance System (DMSS). Deaths of active duty service members were identified from records produced by Service-specific casualty offices and the Armed Forces Medical Examiner System, maintained in the DoD Medical Mortality Registry, and routinely provided for health surveillance purposes to the Armed Forces Health Surveillance Branch.

ICD-9 codes were used to define cases of selected cancers by the affected anatomic site or cell type, as listed in **Table 1**. For surveillance purposes, an incident case of malignant melanoma was defined as (1) two or more medical encounters with diagnoses of "malignant melanoma" in the first diagnostic position (ICD-9: 172.0–172.9) following at least one medical encounter with a diagnostic procedure commonly used to evaluate clinically suspicious lesions; or (2) five or more medical encounters with diagnoses of "malignant melanoma" in the first diagnostic position (if there are no reported relevant diagnostic procedures). Diagnostic procedure codes indicative of malignant melanoma are listed in a previous *MSMR* report.[6] For other cancer diagnoses, incident cases were defined as either one inpatient encounter with a defining diagnosis in the first diagnostic position (or in the second diagnostic position if the first code was a V-code indicating radiotherapy or chemotherapy treatment [ICD-9: V58.0–V58.12]) or three or more outpatient encounters within a 90-day period with the defining diagnosis in the first or second diagnostic position.

Summaries of cancer-related deaths include a category of "other." The "other" category included cancers of unspecified sites or unknown behavior (n=56), myeloma and malignant plasma cell neoplasms (n=10),

TABLE 1. ICD-9 codes used for classification

Selected cancers	ICD-9 codes
Colon/rectum	153.0–154.1, 159.0, 209.1; in situ 230.3, 230.4
Lung/bronchus	162.2–162.9, 209.21; in situ 231.1, 231.2
Female breast	174.0–174.9; in situ 233.0
Cervix	180.0–180.9
Prostate	185; in situ 236.5
Testis	186.0–186.9
Brain	191.0–191.9
Bladder	188.xx; in situ 233.7
Kidney	189.0, 189.1, 209.24; in situ 236.91
Liver	155.xx
Pancreas	157.xx
Stomach	151.xx, 209.23
Ovary	183.xx
Malignant melanoma[a]	172.0–172.9
Non-Hodgkin lymphoma	200.0–200.8, 202.0–202.2, 202.8–202.9
Leukemia	204.0–208.9

[a]Additional diagnostic procedure codes were used in conjunction with the ICD-9 codes (see Ref. 6).

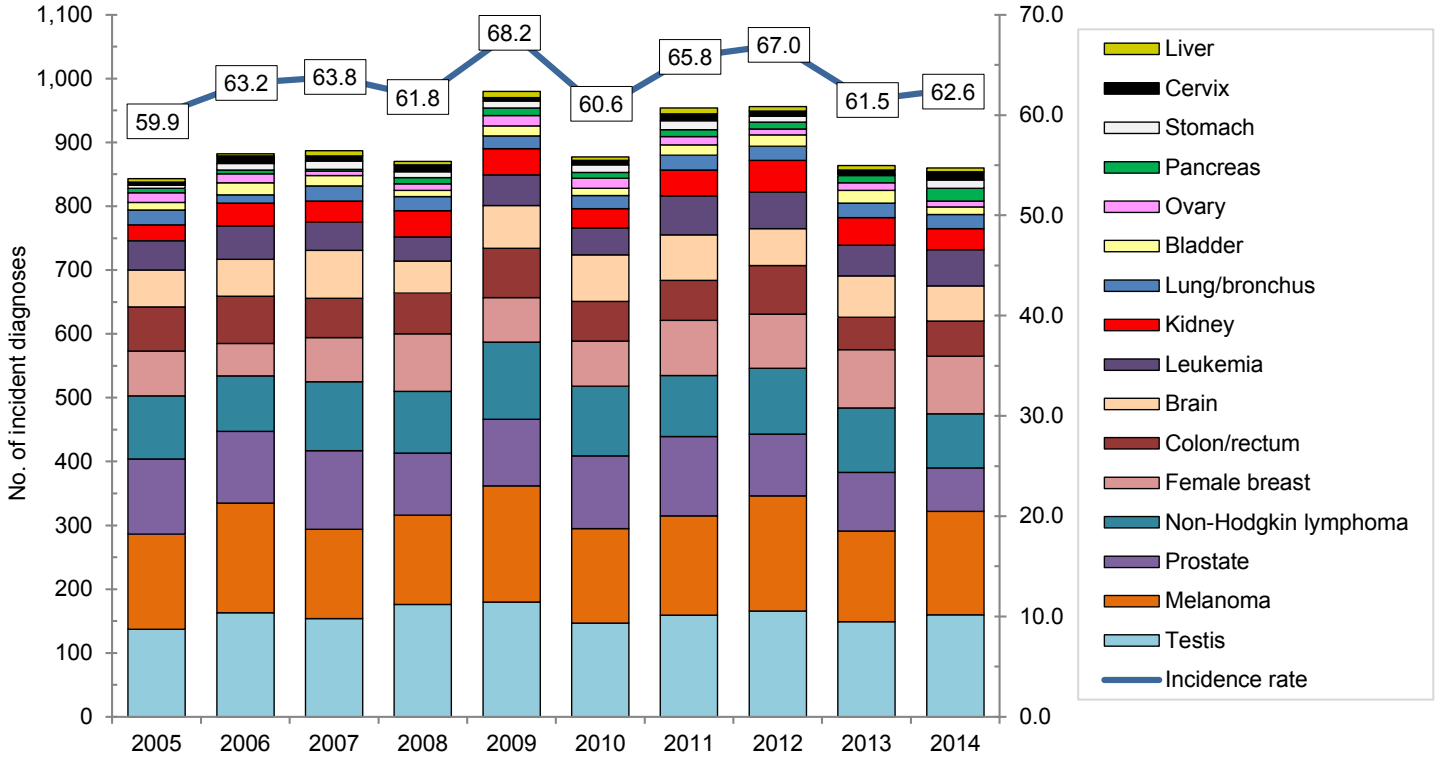
malignant neoplasms of the thymus (n=7), and neoplasms of the eye (n=4) as well as sites of cancers that accounted for fewer than 20 deaths each during the 10-year period: testis (n=19), digestive and endocrine (n=18), Hodgkin lymphoma (n=12), cervix (n=8), ovary (n=7), prostate (n=7), bladder (n=6), gastrointestinal (n=5), central nervous system (n=4), and gynecological (n=1) **(data not shown)**. Incident diagnoses of in situ cancers were included in the diagnosis totals for the relevant cancers (i.e., colon/rectum, lung/bronchus, female breast, prostate, and bladder) **(Figure 1)** but not in the calculation of the incidence rates for these cancers **(Table 2)**.

For surveillance purposes, incident dates of cancer diagnoses were the dates of the first medical encounters of affected individuals that included case-defining diagnoses. Individuals were counted as incident cancer cases only once during the surveillance period (even if cases had diagnoses of more than one cancer type, recurrences of previously treated cancers, metastatic lesions of primary cancers, or a carcinoma in situ that preceded cancer). Military members with case-defining cancer diagnoses prior to the start of the surveillance period were excluded from the analysis (because they were not considered at risk of incident [first-ever] cancer diagnoses during the period). However, any death attributed to cancer that occurred during the surveillance period was counted, although in some cases, the initial diagnosis of cancer for those individuals may have occurred before the beginning of the surveillance period.

RESULTS

During the 10-year surveillance period, 8,973 active component members were diagnosed with at least one of the cancers of interest for this report. Over the 10-year period, the crude rate of incident diagnoses of the subject cancers was 63.4 per 100,000 person-years (p-yrs); the lowest annual incidence rate was 59.9

FIGURE 1. Incident diagnoses of selected cancers[a] and total incidence rate, by year and affected anatomic site/cell type, active component, U.S. Armed Forces, 2005–2014



[a]Incident diagnoses for colorectal, lung/bronchus, female breast, prostate, and bladder include in situ cases.

TABLE 2. Numbers and rates of incident diagnoses of selected cancers, by demographic and military characteristics, active component, U.S. Armed Forces, 2005-2014

	Malignant melanoma			Colon/rectum			Lung/bronchus[a]			Brain/other central nervous system		
	No.	Rate[c]	RR	No.	Rate[c]	RR	No.	Rate[c]	RR	No.	Rate[c]	RR
Total	1,571	11.1		638	4.5		212	1.5		630	4.4	
Service												
Army	490	9.3	ref	237	4.5	ref	90	1.7	ref	228	4.3	ref
Navy	404	12.3	1.32	151	4.6	1.02	53	1.6	0.94	139	4.2	0.98
Air Force	529	16.0	1.72	171	5.2	1.15	50	1.5	0.88	174	5.2	1.21
Marine Corps	148	7.7	0.83	48	2.5	0.56	11	0.6	0.34	70	3.6	0.84
Coast Guard	0	0.0	0.00	31	7.6	1.69	8	2.0	1.15	19	4.7	1.08
Sex												
Male	1,298	10.7	ref	562	4.6	ref	179	1.5	ref	548	4.5	ref
Female	273	13.3	1.24	76	3.7	0.80	33	1.6	1.09	82	4.0	0.88
Race/ethnicity												
White, non-Hispanic	1,436	16.2	ref	411	4.6	ref	132	1.5	ref	473	5.3	ref
Black, non-Hispanic	8	0.3	0.02	122	5.3	1.15	43	1.9	1.26	66	2.9	0.54
Other	127	4.2	0.26	105	3.4	0.74	37	1.2	0.81	91	3.0	0.56
Age												
<20	10	1.1	ref	3	0.3	ref	1	0.1	ref	15	1.7	ref
20–24	157	3.4	3.05	32	0.7	2.07	20	0.4	3.88	147	3.2	1.90
25–29	253	7.5	6.77	69	2.1	6.15	18	0.5	4.81	139	4.1	2.48
30–34	279	13.1	11.71	87	4.1	12.16	24	1.1	10.06	110	5.1	3.08
35–39	330	19.7	17.68	122	7.3	21.77	36	2.1	19.26	103	6.1	3.67
40+	542	35.8	32.12	325	21.4	64.12	113	7.4	66.83	116	7.6	4.57
Military grade												
Enlisted	832	7.0	ref	420	3.6	ref	152	1.3	ref	488	4.1	ref
Officer/other	739	31.1	4.41	218	9.2	2.58	60	2.5	1.96	142	6.0	1.44
Military occupation												
Combat	376	13.0	ref	131	4.5	ref	53	1.8	ref	144	5.0	ref
Health care	210	17.7	1.36	68	5.7	1.26	28	2.4	1.29	65	5.5	1.10
Other	985	9.7	0.75	439	4.3	0.95	131	1.3	0.70	421	4.2	0.83
	Leukemia			Female breast[a,b]			Cervix[b]			Prostate[a,b]		
	No.	Rate[c]	RR	No.	Rate[c]	RR	No.	Rate[c]	RR	No.	Rate[c]	RR
Total	493	3.5		652	31.8		87	4.2		1,046	8.6	
Service												
Army	201	3.8	ref	260	36.2	ref	32	4.5	ref	513	11.3	ref
Navy	109	3.3	0.87	124	24.2	0.67	15	2.9	0.66	205	7.4	0.66
Air Force	116	3.5	0.92	225	35.4	0.98	29	4.6	1.02	235	8.8	0.78
Marine Corps	54	2.8	0.74	21	16.5	0.46	5	3.9	0.88	47	2.6	0.23
Coast Guard	13	3.2	0.83	22	41.1	1.13	6	11.2	2.51	46	13.0	1.15
Sex												
Male	434	3.6	ref	na	na	na	na	na	na	1,045	8.6	na
Female	59	2.9	0.80	652	31.8	na	87	4.2	na	na	na	na
Race/ethnicity												
White, non-Hispanic	330	3.7	ref	312	31.4	ref	53	5.3	ref	591	7.5	ref
Black, non-Hispanic	60	2.6	0.70	221	40.7	1.29	14	2.6	0.48	345	19.9	2.64
Other	103	3.4	0.91	119	23.3	0.74	20	3.9	0.73	109	4.3	0.57
Age												
<20	27	3.0	ref	0	0.0	0.00	0	0.0	0.00	0	0.0	0.00
20–24	120	2.6	0.86	22	3.1	ref	8	1.1	ref	4	0.1	ref
25–29	88	2.6	0.87	53	10.4	3.29	21	4.1	3.59	4	0.1	1.38
30–34	70	3.3	1.09	91	30.4	9.65	20	6.7	5.83	4	0.2	2.14
35–39	74	4.4	1.47	145	70.2	22.32	26	12.6	11.01	27	1.8	18.10
40+	114	7.5	2.50	341	186.2	59.18	12	6.6	5.73	1,006	76.5	748.91
Military grade												
Enlisted	379	3.2	ref	407	24.3	ref	59	3.5	ref	457	4.5	ref
Officer/other	114	4.8	1.49	245	66.3	2.73	28	7.6	2.15	588	29.5	6.53
Military occupation												
Combat	94	3.3	ref	34	29.0	ref	4	3.4	ref	207	7.5	ref
Health care	56	4.7	1.45	174	44.1	1.52	19	4.8	1.41	167	21.3	2.84
Other	343	3.4	1.04	444	28.9	1.00	64	4.2	1.22	671	7.8	1.04

[a]In situ cancers are not included.

[b]For gender-specific cancers, rates as based on p-yrs of service of the respective gender only

[c]Incident diagnoses per 100,000 p-yrs of military service

RR, rate ratio

TABLE 2 (cont). Numbers and rates of incident diagnoses of selected cancers, by demographic and military characteristics, active component, U.S. Armed Forces, 2005–2014

	Non-Hodgkin lymphoma			Testis[b]			Bladder[a]			Stomach		
	No.	Rate[c]	RR	No.	Rate[c]	RR	No.	Rate[c]	RR	No.	Rate[c]	RR
Total	1,006	7.1		1,591	13.1		148	1.0		98	0.7	
Service												
Army	364	6.9	ref	555	12.2	ref	52	1.0	ref	48	0.9	ref
Navy	235	7.2	1.04	376	13.6	1.11	39	1.2	1.20	18	0.5	0.60
Air Force	276	8.3	1.21	376	14.1	1.15	42	1.3	1.28	24	0.7	0.79
Marine Corps	99	5.2	0.75	224	12.5	1.02	8	0.4	0.42	8	0.4	0.46
Coast Guard	32	7.8	1.13	60	17.0	1.39	7	1.7	1.74	0	0.0	0.00
Sex												
Male	894	7.4	ref	1,591	13.1	na	141	1.2	ref	85	0.7	ref
Female	112	5.4	0.74	na	na	na	7	0.3	0.29	13	0.6	0.90
Race/ethnicity												
White, non-Hispanic	660	7.4	ref	490	4.6	ref	105	1.2	ref	44	0.5	ref
Black, non-Hispanic	171	7.5	1.00	164	5.5	1.22	12	0.5	0.44	31	1.4	2.73
Other	175	5.7	0.77	108	3.2	0.71	31	1.0	0.86	23	0.8	1.52
Age												
<20	38	4.2	ref	2	0.2	ref	1	0.1	ref	0	0.0	0.00
20–24	220	4.8	1.12	47	0.8	5.20	7	0.2	1.36	8	0.2	ref[d]
25–29	197	5.9	1.39	78	2.1	13.14	20	0.6	5.35	14	0.4	2.41
30–34	137	6.4	1.51	110	4.4	27.73	20	0.9	8.39	12	0.6	3.24
35–39	162	9.7	2.28	161	7.5	46.85	32	1.9	17.12	24	1.4	8.27
40+	252	16.6	3.92	364	20.4	127.70	68	4.5	40.21	40	2.6	15.22
Military grade												
Enlisted	750	6.3	ref	516	3.6	ref	97	0.8	ref	70	0.6	ref
Officer/other	256	10.8	1.69	246	8.9	2.45	51	2.1	2.61	28	1.2	1.98
Military occupation												
Combat	205	7.1	ref	152	4.3	ref	31	1.1	ref	20	0.7	ref
Health care	102	8.6	1.21	76	5.5	1.28	15	1.3	1.18	12	1.0	1.46
Other	699	6.9	0.97	534	4.4	1.02	102	1.0	0.94	66	0.7	0.94
	Kidney			Liver			Pancreas			Ovary[b]		
	No.	Rate[c]	RR	No.	Rate[c]	RR	No.	Rate[c]	RR	No.	Rate[c]	RR
Total	373	2.6		65	0.5		100	0.7		121	5.9	
Service												
Army	169	3.2	ref	27	0.5	ref	33	0.6	ref	42	5.9	ref
Navy	80	2.4	0.76	17	0.5	1.01	26	0.8	1.26	35	6.8	1.17
Air Force	84	2.5	0.79	13	0.4	0.77	30	0.9	1.45	36	5.7	0.97
Marine Corps	25	1.3	0.41	5	0.3	0.51	4	0.2	0.33	6	4.7	0.81
Coast Guard	15	3.7	1.15	3	0.7	1.43	7	1.7	2.74	2	3.7	0.64
Sex												
Male	329	2.7	ref	60	0.5	ref	78	0.6	ref	na	na	na
Female	44	2.1	0.79	5	0.2	0.49	22	1.1	1.66	121	5.9	na
Race/ethnicity												
White, non-Hispanic	237	2.7	ref	31	0.3	ref	57	0.6	ref	53	5.3	ref
Black, non-Hispanic	66	2.9	1.08	14	0.6	1.75	24	1.0	1.63	32	5.9	1.10
Other	70	2.3	0.86	20	0.7	1.87	19	0.6	0.97	36	7.1	1.32
Age												
<20	1	0.1	ref	1	0.1	0.00	0	0.0	0.00	2	1.4	0.00
20–24	18	0.4	3.50	9	0.2	ref	5	0.1	ref	20	2.9	ref
25–29	32	1.0	8.56	6	0.2	0.92	6	0.2	1.65	28	5.5	1.91
30–34	63	2.9	26.42	8	0.4	1.92	7	0.3	3.02	18	6.0	2.10
35–39	75	4.5	40.14	17	1.0	5.20	17	1.0	9.37	13	6.3	2.20
40+	184	12.1	108.85	24	1.6	8.12	65	4.3	39.59	40	21.8	7.64
Military grade												
Enlisted	291	2.5	ref	50	0.4	ref	66	0.6	ref	83	4.9	ref
Officer/other	82	3.4	1.40	15	0.6	1.49	34	1.4	2.56	38	10.3	2.08
Military occupation												
Combat	63	2.2	ref	7	0.2	ref	20	0.7	ref	9	7.7	ref
Health care	50	4.2	1.93	7	0.6	2.44	14	1.2	1.70	28	7.1	0.92
Other	260	2.6	1.18	51	0.5	2.07	66	0.7	0.94	84	5.5	0.71

[a]In situ cancers are not included.
[b]For gender-specific cancers, rates as based on p-yrs of service of the respective gender only
[c]Incident diagnoses per 100,000 p-yrs of military service
[d]Reference group for this cancer uses 20–24 age category instead of <20 years used for other cancers
RR, rate ratio

per 100,000 p-yrs in 2005 and the highest annual incidence rate was 68.2 per 100,000 p-yrs in 2009 **(Figure 1)**.

From 2005 through 2014, the numbers of incident diagnoses of non-gender-specific cancers were malignant melanoma (n=1,571), non-Hodgkin lymphoma (n=1,006), colorectal cancer (malignant carcinoma n=638; in situ n=15), brain cancer (n=630), leukemia (n=493), kidney cancer (n=373), cancer of the lung/bronchus (malignant carcinoma n=212; in situ n=1), bladder cancer (malignant carcinoma n=148, in situ n=2), cancer of the pancreas (n=100), stomach cancer (n=98), and liver cancer (n=65). Among males, the most frequent cancer diagnoses were testicular cancer (n=1,591), malignant melanoma (n=1,298), prostate cancer (malignant carcinoma n=1,046; in situ n=3), non-Hodgkin lymphoma (n=894), and colorectal cancer (malignant carcinoma n=562; in situ n=12); among females, the most frequent cancer diagnoses were breast cancer (malignant carcinoma n=652; in situ n=121), malignant melanoma (n=273), ovarian cancer (n=121), non-Hodgkin lymphoma (n=112), and cervical cancer (n=87) **(Figure 1)**. There were no clear trends of increasing or decreasing cancer diagnosis incidence of specific sites or overall; however, there was suggestive evidence of a decrease in prostate cancer incidence **(Figures 1, 2a, 2b)**.

In general, the strongest demographic correlate of increased risk of a cancer diagnosis was older age. For example, for all cancer sites except the cervix, the highest rates of diagnoses were among those aged 40 years or older **(Tables 2)**. For a majority of the cancers examined, with the exception of malignant melanoma, cervical, testicular, stomach, and ovarian cancers, crude incidence rates were lower among members of the Marine Corps than the other Services. Military members in healthcare occupations had relatively higher rates of all of the cancers of interest; the three highest crude rate ratios (RRs) in this occupational group were for prostate (RR: 2.84), liver (RR: 2.44), and kidney cancers (RR: 1.93) **(Tables 2)**. Compared to males, females had lower crude incidence rates of colorectal cancer and non-Hodgkin lymphoma, leukemia, brain/other CNS, and kidney. A similar gender difference is evident in the general U.S. population.[7] However, whereas melanoma is more common among males in the general U.S. population, in this analysis, females had a higher crude rate of malignant melanoma (RR: 1.24) compared to males. Consistent with published literature, the incidence rate for prostate cancer in black, non-Hispanic males was about two and one-half times that observed in white, non-Hispanic males[8]; however, black, non-Hispanic males had crude incidence rates of testicular cancer only slightly higher than those of white, non-Hispanic males. As found in previous analyses, white, non-Hispanic service members had a much higher crude rate of malignant melanoma relative to their counterparts in other race/ethnicity groups **(Table 2)**.[9,10]

During the surveillance period, cancers accounted for 1,054 deaths of service members on active duty; this total included 727 service members in the active component and 327 in the reserve component **(Figures 3a, 3b)**. The number of cancer-related deaths per year markedly varied during the period; the fewest deaths per year for members of the active component were in 2014 (n=45) and the most were in 2011 and 2012 (n=86 for both years) **(data not shown)**. The cancers (by affected organ system or cell) that caused the most deaths among service members in the active component during the period were colon/rectum (n=84), leukemia (n=84), and

FIGURE 2a. Incidence rates of selected cancers in males, active component, U.S. Armed Forces, 2005–2014

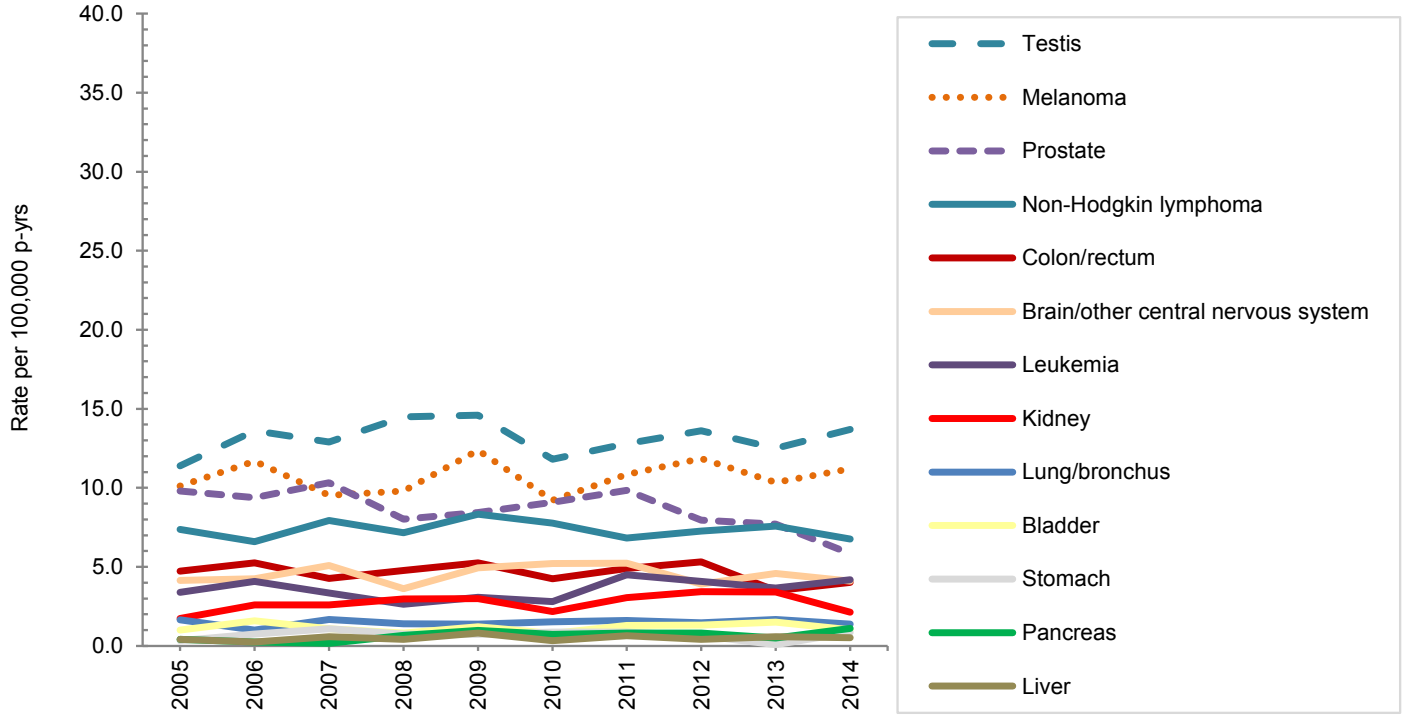


FIGURE 2b. Incidence rates of selected cancers in females, active component, U.S. Armed Forces, 2005–2014

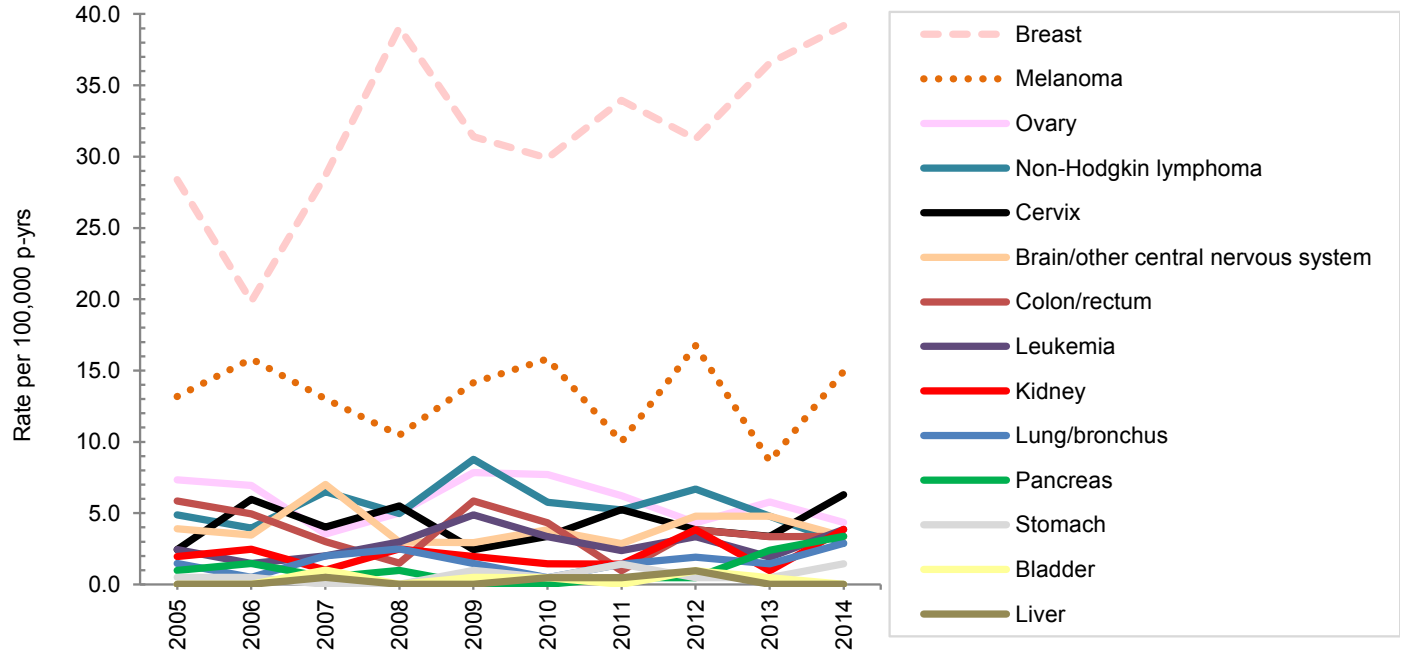


FIGURE 3a. Cancer-related deaths by year and affected anatomic site/cell type, active component, U.S. Armed Forces, 2005–2014

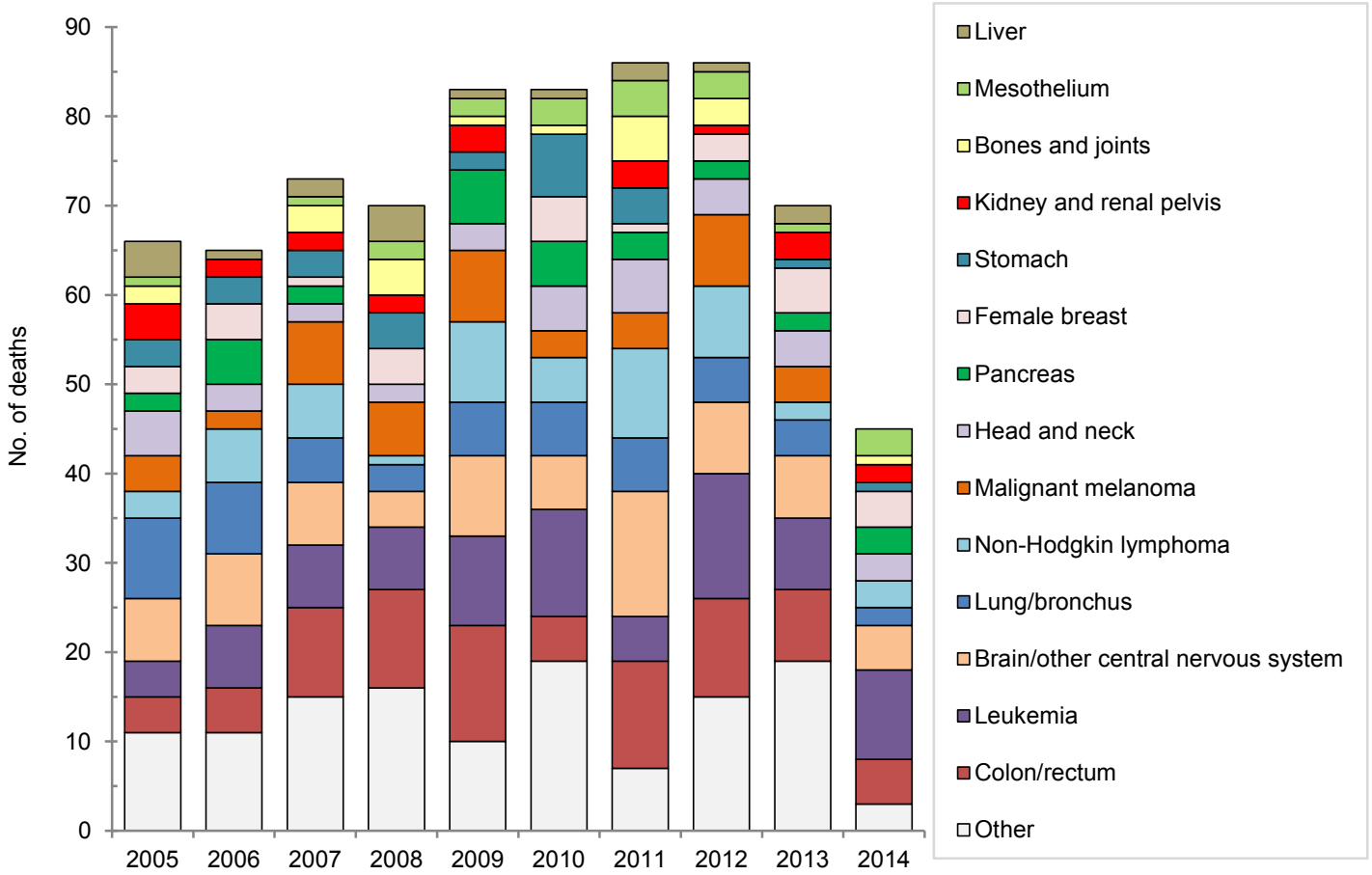
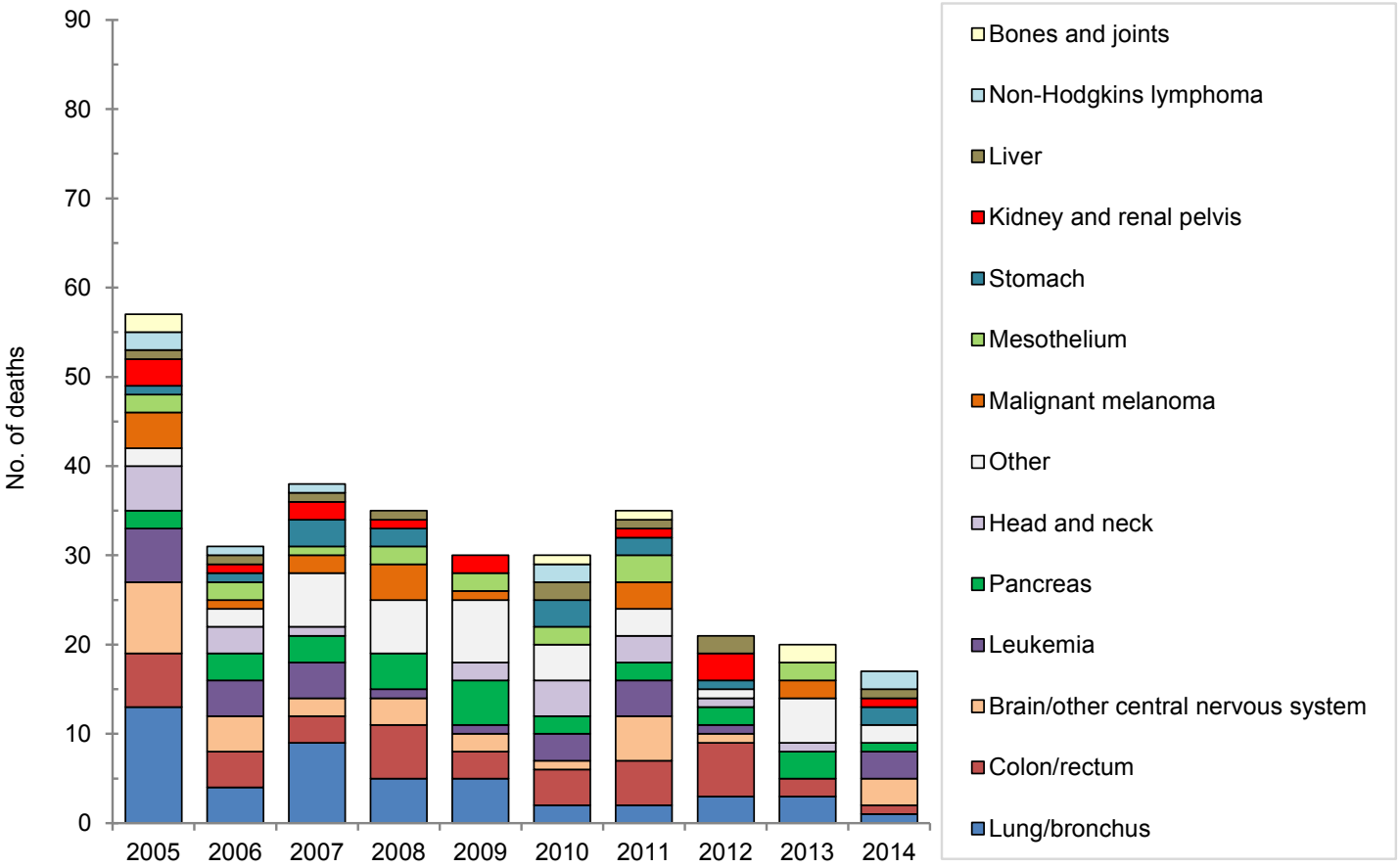


FIGURE 3b. Cancer-related deaths by year and affected anatomic site/cell type, reserve component, U.S. Armed Forces, 2005–2014



brain/other central nervous system (n=75) **(Figure 3a)**. Among service members in the reserve component, the cancers that caused the most deaths were lung/bronchus (n=47), colon/rectum (n=40) and brain/other central nervous system (n=29) **(Figure 3b)**. There was suggestive evidence of a decrease in the number of lung/bronchus cancer deaths during this period. There were no obvious temporal trends for cancer deaths among service members in the active component.

EDITORIAL COMMENT

Over the past 10 years, overall rates of diagnoses of the cancers of interest for this report have been relatively stable among active component members of the U.S. military. However, within the active component, there is suggestive evidence that there has been a decrease in the crude prostate cancer incidence rate. Within the reserve component, there is suggestive evidence that there has been a decrease in the total number of lung cancer deaths. A decrease in these measures is in line with trends seen in the general U.S. population from the National Cancer Institute's cancer registry data from SEER (Surveillance, Epidemiology, and End Results Program) as a 5.1% decrease per year for prostate cancer incidence and a 2.2% decrease in lung cancer death rate per year were observed between 2004 and 2013.[7] It is interesting to note that, for the other cancers considered in this report, there were no other obvious trends observed while data from SEER show marked changes in some cancer rates. Between 2004 and 2013, for example on average, there have been yearly percentage increases in the incidence rates of melanoma (1.4%), testicular cancer (0.8%), and kidney cancer (1.1%), and yearly percentage decreases in the incidence of colon/rectum (3.2%), lung/bronchus (1.8%), ovarian (1.9%), and cervical cancers (0.9%).[7]

In addition to the cancers considered in previous *MSMR* analyses,[4,5] this report included bladder, kidney, liver, pancreas, stomach, and ovarian cancers as well as in situ cancers of the bladder, colon/rectum, lung/bronchus, female breast, and prostate. Because of this difference, numbers of incident diagnoses and cancer incidence rates presented in this report are not directly comparable to results of previous *MSMR* analyses. The overall numbers of incident cancer diagnoses for this report are larger due to the inclusion of more cancers, but additionally, the numbers for individual cancers may have decreased.

In the current analysis, only the earliest dates of cancer diagnosis for affected individuals are counted and individuals could only be counted once (e.g., for individuals with in situ cancers that preceded malignant neoplasms, only the in situ cancers were counted; for individuals with two malignant cancer diagnoses during the surveillance period, only the first cancer was counted).

There are several potential limitations to the analyses that should be taken into account when interpreting the results. First, cancer cases were ascertained from ICD-9-coded diagnoses recorded on standardized records of hospitalizations and outpatient medical encounters. Because pathology reports and cancer registry records were not reviewed to confirm cancer diagnoses, some cancer-specific diagnoses considered case-defining for this report may reflect erroneous or miscoded diagnoses (e.g., cancer-specific codes may have been recorded for some "rule out" or suspected cases). Because of this potential lack of specificity of cancer diagnoses, counts of cancer cases presented in this report may overestimate the actual numbers of cancers definitively diagnosed among active component military members during the surveillance period. On the other hand, while ACTUR (the DoD tumor registry) and SEER are considered gold standards for cancer case identification in the U.S., cases that are registered likely underestimate the total of all cancers that affect the populations of interest. Interpretations of the findings of various population-based cancer studies should consider the likely completeness and accuracy of case ascertainment of the data sources used.

The data source used in this report, the DMSS, contains records of nearly all medical encounters of active component military members in "fixed" (i.e., not deployable or at sea) military and non-military medical treatment facilities. The use of administrative medical records to conduct and enhance cancer surveillance has been studied extensively. In general, the ability of administrative medical records to identify incident cases of cancers has been good, depending on the types of cancers examined and definitions used for case ascertainment. For example, estimates of incidence rates of lung, breast, and colon cancers using administrative data were found to be within 6% of the respective incidence rates that were estimated by using SEER data.[11–14]

An important determinant of the quality of health surveillance in general is the completeness and accuracy of case finding. In turn, the criteria used to detect and categorize cases for surveillance purposes (e.g., as possible, likely, or confirmed cases) significantly impact counts of cases of specific conditions and surveillance findings and their implications in general. To inform the selection of cancer case definitions, several case finding algorithms were reviewed before deciding on the case definitions used for this report.[15]

Another potential limitation of the analysis relates to cancers that may be considered indolent. One requirement of the case definitions employed (with the exception of malignant melanoma) is three or more outpatient medical encounters occurring within a 90-day period, with any defining diagnoses of the cancer of interest in the primary or secondary diagnostic position. Cases of cancers that may be considered indolent, such as prostate cancer, may not be captured in this 90-day window leading to a possible underestimate of the number of incident diagnoses of this cancer type.

In regard to cancer deaths, it should be noted that the analysis did not include deaths among reserve component members who were not on active duty at the times of their deaths. For active component service members, it is uncertain what factors may have been responsible for the 2014 decline in numbers of deaths. There has been no change in the routine reporting of deaths to the AFHSB as described in Methods. There is no evidence to permit a conclusion that the 2014 numbers reflect any dramatic decline in cancer incidence or case fatality rates. At this point, there are no data to suggest that service members with terminal cancer left active service (e.g., retired) before death at higher rates than has previously been the case. The potential impact of the gradual reduction in size of the Armed Forces is also uncertain. In summary, there is no ready explanation for the decline in 2014 deaths. Follow-up study of mortality trends over time may permit a better understanding.

Active military populations differ from the U.S. civilian population in numerous ways. Many factors that differ in the populations affect both the incidence of, and mortality from, cancers. For example, the incidence rates of most cancers increase with age, and many behavioral factors such as tobacco smoking, diet and alcohol consumption, physical exercise, medication use, infectious disease experience, and history of sun exposure are associated with cancer risk. The U.S. military population is younger and, in general, healthier than the U.S. adult population. All applicants for military service are medically examined before induction and those with specified medical conditions (e.g., prevalent cancers, HIV-1 infections) are disqualified from entering service. Because of the nature of some military occupations (in particular, combat occupations), obesity and sedentary life styles (which are correlates of risk for some cancers) are not common. In addition, all military services have height, weight, and physical fitness standards for all service members. Military members may seek care for signs or symptoms of cancers at early clinical stages and are more likely to undergo cancer screening since members have unlimited access to health care at no cost to the themselves and are required to undergo periodic medical examinations that may include cancer screening examinations such as mammography, prostate-specific antigen testing, and cytologic examination of the cervix (Papanicolaou smear). Cancers may be detected earlier in their clinical courses in members of the active military than in civilian populations. If so, rates of cancer diagnoses may be higher among active military members than similarly aged civilians (because they are detected earlier); however, the detection and treatment of cancers at earlier stages may decrease cancer-related mortality among military members compared to civilians.

Temporal trends of rates of cancer diagnoses should be interpreted in light of not only changes in screening practices, but also changes in behavioral risk factors relative to the clinical latencies of cancers of interest. For example, cigarette smoking is a significant risk factor for several cancers. Although the U.S. military discourages cigarette

smoking by its members and prohibits smoking in some settings, smoking prevalence remains higher among active military members (24%) than in the general U.S. population (19%).[16] This report documented a low incidence of lung cancers among military members; however, this finding may reflect the long latency of smoking-related lung cancer.[17] Lung cancer cases related to current tobacco smoking may not be clinically apparent until after affected members leave active service.[18,19] Unquestionably, smoking cessation and other modifiable risk factors for cancer including physical and "nutritional fitness" and prevention and early treatment of alcohol misuse and abuse should be priorities for all military healthcare and public health practitioners.

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