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Numbers and Proportions of U.S. Military Members in Treatment for Mental Disorders over Time, Active Component, January 2000–September 2013

This report examines trends in health record documentation of the treatment for mental disorders of active component U.S. military service members from January 2000 through September 2013. Inpatient and outpatient records were used to estimate the numbers and proportions of service members who received such treatment and the durations and intensities of courses of treatment. Annual numbers of service members who received treatment for mental disorders and the annual numbers of treatment courses increased steadily from 2004–2012. More than half of service members who received such treatment had only one treatment course, but the annual numbers of such single treatment courses increased by 60% during the 13-year surveillance period. Annual numbers of treatment courses that consisted of more than 30 encounters increased 5.6-fold between 2001 and 2012 and the mean number of days per treatment course markedly increased during the last half of the period. The proportion of overall service time contributed by members who were in treatment for mental disorders increased from about 1% in 2000 to 3.5% in 2012. The methods and findings of this analysis are compared and contrasted with other published studies and reports about mental health problems in the Armed Forces since the beginning of the wars in Afghanistan and Iraq.

The productivity of a workforce is inherently related to the psychological health of the workers.¹ A study of more than 60,000 full-time workers in Australia found that 14.1% had “moderate” or “high” psychological distress, that higher levels of distress were associated with lower productivity, and that employees who were treated successfully for mental disorders had nearly the same productivity as those with no such histories.² Such findings suggest that mental health programs in the workplace should focus on identifying and enabling treatment for performance-degrading mental disorders.

The U.S. military is a unique workforce because military service, especially during wartime, is often dangerous, sometimes life threatening, and inherently stressful. Not surprisingly, since the beginning of combat operations in Fall 2001, there have been large and increasing numbers of veteran and current military members with self-reported and clinically diagnosed mental disorders.³ The experience reflects, at least

in part, the increased psychological stresses associated with prolonged warfighting, repeated deployments, and widespread and recurrent exposures to war-related suffering and death. However, the marked increases in mental disorder–related diagnoses also reflect the effects of mandatory screening after wartime deployments; increased awareness of and concerns regarding mental disorders by senior leaders and policy-makers; and the effects of new policies and leadership initiatives aimed at decreasing stigmas associated with seeking and receiving mental health–related care and increasing access to behavioral health evaluations and treatments.^{4–7}

If most military members with clinically significant, socially disruptive, or military performance-degrading behavioral health problems sought or were referred for mental disorder–related treatments, then the numbers and proportions of military members “in treatment” for mental disorders over time would reliably indicate the status and trends of the psychological

health of the force. However, if many military members with clinically significant mental disorders avoided indicated evaluations and treatments, or if the proportions of those affected who were in treatment significantly changed over time, then the numbers and proportions in treatment would not reliably indicate the status and trends of the psychological health of the force.

This report uses inpatient and outpatient healthcare records to estimate the numbers and proportions of U.S. military members who began treatment for mental disorders during the interval January 2000 through December 2012. It also documents trends in the durations and intensities (i.e., clinical encounters per treatment course) of mental disorder–related treatment courses over the 13-year surveillance period. The results are assessed in relation to those of recent studies that have estimated the prevalences of mental disorders in selected subgroups of veteran and actively serving military populations.

METHODS

The surveillance period was 1 January 2000 through 30 September 2013. The surveillance population included all individuals who served in the active component of the U.S. Armed Forces any time during the surveillance period. Individuals who had a mental disorder–related encounter between 1 January 2000 and 31 December 2012 were included in summaries of mental disorder–related courses of treatment. If a course of treatment began during this period and extended into calendar year 2013, the time accrued to the treatment course until 30 September 2013. Follow-up ended at 30 September 2013. Individuals beginning a new course of treatment after 1 January 2013 were excluded from this analysis. For surveillance purposes, a “mental disorder–related medical encounter” was defined as a hospitalization or ambulatory visit that was documented with a standardized electronic

TABLE 1. Diagnostic codes (ICD-9-CM) considered indicators of mental disorder-related medical encounters

Description	ICD-9 codes
ICD-9 mental disorders	290–319 (excluding 305.1, 299.xx, 315.xx, 317.xx-319.xx)
V-coded mental disorders	
Psychological trauma	V15.4
Other psychological or physical stress	V62.x (excluding V62.0)
Person feigning illness (malingering)	V15.4

healthcare record that included a mental disorder-specific diagnosis in the first or second diagnostic position. Diagnostic codes (ICD-9-CM) that were considered indicative of mental disorder-related medical encounters are listed in Table 1.

For estimation purposes, each mental disorder-related “course of treatment” was defined as the time from an “initial” mental disorder-related encounter until the last “follow-up” encounter where each follow-up encounter occurred within 60 days of the preceding such encounter. “Initial encounters” of treatment courses included each individual’s first mental disorder-related encounter while in active service; and each mental disorder-related encounter that occurred more than 60 days after any prior such encounter.

For summary purposes, initial encounters with no follow-up encounters within 60 days were considered courses of treatment of 1-day duration; and each course of treatment was attributed to the calendar year that it began. Also, each individual could have multiple initial encounters and thus multiple courses of treatment during the surveillance period.

RESULTS

During each year of the surveillance period, from 132,079 (in 2000) to 232,184 (in 2012) active component members received initial diagnoses of mental disorders (Figure 1). The affected service members accounted for 2,698,903 mental disorder-related treatment courses overall (per the definition of treatment course used here) (Table 2).

Affected individuals

From 2000 through 2003, there was remarkable consistency in the annual numbers of service members who received initial diagnoses of mental disorders (Figure 1, Table 2). However, from 2004 through 2012, annual numbers of service members with at least one initial mental disorder-related diagnosis steadily and markedly increased. As such, 76% more service members received initial mental disorder diagnoses in 2012 than in 2000.

Treatment courses

Annual numbers of treatment courses remained fairly stable from 2000 through 2003 but markedly increased in 2004, 2005, and from 2006 through 2012 (Figure 1, Table 2). As such, there were 88% more treatment

courses in 2012 (n=288,757) than in 2000 (n=153,805).

Of all service members with at least one mental disorder-specific diagnosis during the period, more than half (57.7%) had only one treatment course (data not shown). Approximately one of five (20.9%) affected service members had two treatment courses. One of 10 (9.7%) had three treatment courses, and one of eight (11.8%) had more than three treatment courses. Over the entire period, the mean number of treatment courses per affected service member was 1.94.

Encounters per treatment course

During the surveillance period, 45.1% of all mental disorder-related treatment courses entailed only one encounter (Figure 2). The mean and median numbers of encounters per treatment course were 6.8 and 2, respectively (Figure 3). The range of encounters per treatment course was 1 to 1,066.

The numbers of single-visit treatment courses per year generally increased throughout the period; as a result, there were approximately 60% more single-visit treatment courses in 2012 (n=110,346) than in 2000 (n=68,859). However, the proportions of treatment courses that consisted of one visit only remained fairly stable from 2000 (44.8%) through 2005

FIGURE 1. Number of military members who received initial mental disorder diagnoses and number of treatment courses for mental disorders, by year, active component, U.S. Armed Forces, 2000–2012

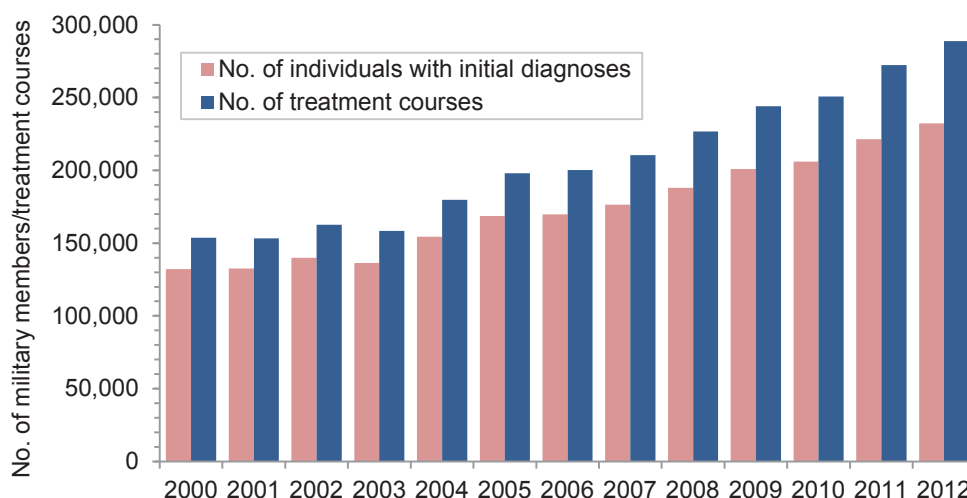


TABLE 2. Numbers and durations of mental disorder-related treatment courses, by year, active component, U.S. Armed Forces, 2000–2012

Year	No. of individuals with at least one "initial" mental disorder diagnosis ^a	No. of mental disorder treatment courses	Days in mental disorder treatment	Total days of service by active component members	% of total days of active component service during which members were in treatment for mental disorders
2000	132,079	153,805	5,709,205	510,832,989	1.12
2001	132,597	153,228	5,028,289	510,711,544	0.98
2002	139,985	162,675	5,239,703	521,119,118	1.01
2003	136,390	158,292	5,426,927	529,732,273	1.02
2004	154,330	179,767	6,314,137	530,740,899	1.19
2005	168,516	197,960	6,809,797	516,907,972	1.32
2006	169,675	200,104	7,650,293	513,238,231	1.49
2007	176,404	210,491	9,546,419	511,276,545	1.87
2008	188,065	226,761	11,858,127	518,307,483	2.29
2009	200,942	244,047	14,054,475	527,469,039	2.66
2010	205,936	250,776	15,536,241	532,667,078	2.92
2011	221,398	272,230	17,656,483	531,988,436	3.32
2012	232,184	288,767	18,348,668	524,266,715	3.50
Total	2,258,501	2,698,903	129,178,764	6,779,258,322	1.91

^aSome individuals were affected (and included in this summary) in more than one year.

(47.3%) but steadily decreased through 2012 (38.2%) (**Figure 2**).

In regard to relatively intensive treatments, annual numbers of courses that consisted of more than 30 encounters each increased 5.6-fold between 2001 (n=2,992) and 2012 (n=19,869) (**data not shown**). The proportions of treatment courses that consisted of 30 or more visits each remained fairly stable from 2000 (2.4%) through 2005 (2.4%) but steadily increased through 2011 (7.0%).

Days in treatment

The mean and median durations of treatment courses overall were 47.9 days and 7 days, respectively. The durations of treatment courses ranged from 1 to 2,560 days (**data not shown**).

The mean number of days per treatment course remained fairly stable from 2000 through 2005 (range, 32.2–37.1 days) but steadily and markedly increased from 2006 through 2011 (mean days per treatment course, 2006: 38.2 days; 2011: 64.9 days) (**Figure 3**).

During the first 6 years of the surveillance period, the distributions of durations of treatment courses did not markedly change (**Figure 4**). For example, from 2000

through 2005, the percentages of treatment courses with durations of 1 day ranged from 47.2% to 50.9%, while those with durations greater than 98 days ranged from 9.4% to 11.2%. However, from 2006 through 2012, the percentages of treatment courses of 1-day durations declined from 47.3% to 40.6%, while those with durations

greater than 98 days increased from 11.5% to 20.8%. Because of the lengthening of treatment courses, from 2006 through 2012, total duty days served while in treatment for mental disorders per year increased relatively much more rapidly than the number of treatment courses per year (**Figure 4**).

FIGURE 2. Percentages of treatment courses of one visit only or more than 10 visits in relation to the percentage of duty time overall served by those in treatment for mental disorders, by year, active component, U.S. Armed Forces, 2000–2012

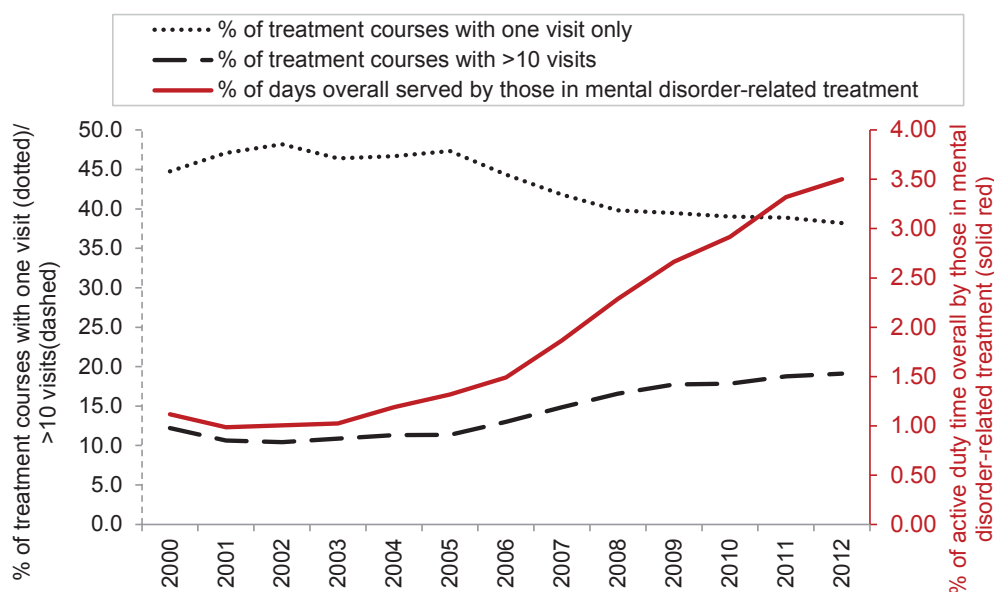


FIGURE 3. Mean numbers of clinical encounters during and durations (in days) of mental disorder-related treatment courses, by year, active component, U.S. Armed Forces, 2000–2012

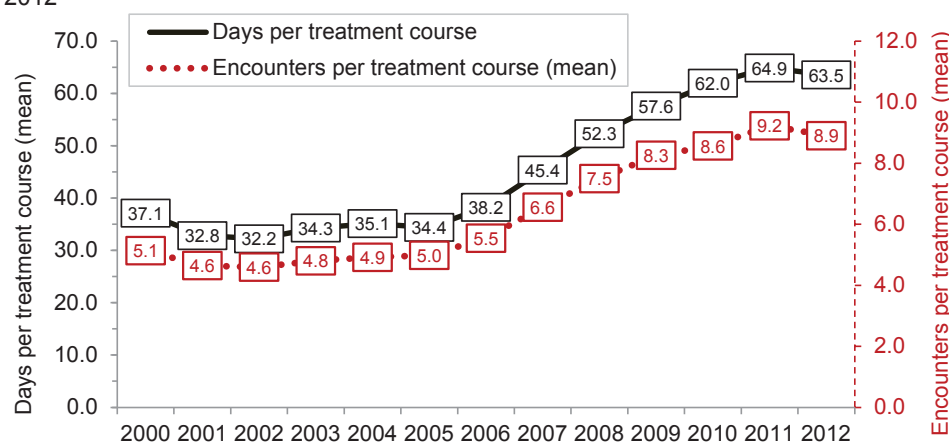
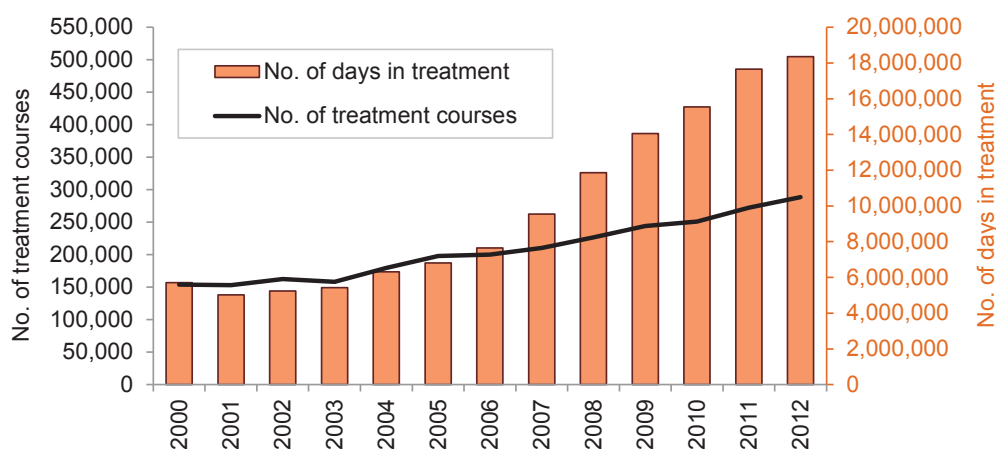


FIGURE 4. Mental disorder-related treatment courses and total days of military service while engaged in mental disorder-related treatment, active component, U.S. Armed Forces, 2000–2012



Proportion of military service time overall served by those in MD-related treatment

The annual number of duty days served by active component members who were in mental disorder–related treatment remained fairly stable from 2000 ($n=5,709,205$ days) through 2003 ($n=5,426,927$ days), steadily increased through 2006 ($n=7,650,293$ days), and then sharply increased through 2012 ($n=18,348,668$ days) (Table 2). Of note, the number of duty days per year served by active component members in mental disorder–related treatment more than tripled from 2000 to 2012.

The proportion of military service time overall contributed by active component members who were in treatment for mental disorders remained fairly stable from 2000 through 2003 (range: 0.98%–1.12%) but increased more than twofold from 2003 through 2012 (3.50%) (Table 2, Figure 2).

EDITORIAL COMMENT

In 2012, U.S. military members were engaged in treatment for mental disorders during more than 50,000 person-years of active service; as such, at any given time

during 2012, approximately 1 of 29 active component members were in treatment for mental disorders.

In the past 13 years, the highest annual percentage of duty days served by active component members who were in treatment for mental disorders (3.5%) was in 2012. The estimated proportion of all military members in treatment for mental disorders in 2012 (3.5%) was approximately 3.5 times that in 2000 (0.99%), the year preceding the September 11 terrorist attacks and the beginning of ground combat in Afghanistan.

Numerous reports have documented the large and increasing numbers of active and veteran U.S. military members who have acknowledged or been diagnosed with behavioral health problems since the beginning of the wars in Afghanistan and Iraq. For example, a frequently cited RAND Corp. study found that, among study volunteers who were military veterans and had served in Iraq or Afghanistan, 14% screened positive for post-traumatic stress disorder (PTSD) and 14% screened positive for depression. The report also estimated that only approximately half of those who screened positive for either PTSD or depression had sought care.⁴

Other studies have assessed the behavioral health of currently serving military members. For example, Riddle and colleagues estimated the prevalence of mental disorders among members of the U.S. Armed Forces in 2001–2003 based on questionnaire responses of a representative sample of currently serving military members ($n=77,047$).⁸ Overall, 18.1% of the respondents met criteria for any mental disorder; the most prevalent mental disorder by far was alcohol abuse (11.9%). The findings are noteworthy because they document a fairly high prevalence of self-reported mental disorders among actively serving military members prior to the start of combat operations in Iraq.

A more recent study estimated the “30-day prevalence” of mental disorders among U.S. Army members in 2011 based on questionnaire responses of a representative sample ($n=5,428$) of non-deployed, non-recruit, active duty soldiers.⁹ Overall, 25.1% of the respondents met criteria for any

mental disorder; the most prevalent mental disorders were intermittent explosive disorder (11.2%), PTSD (8.6%), and attention deficit hyperactivity disorder (7.0%).

Also of note, each year from 2010 to 2013, U.S. military Joint Mental Health Advisory Teams (MHATs) conducted surveys of randomly selected ground combat units in Iraq and Afghanistan.⁵ In their annual reports, MHATs estimated that 10.0%–17.3% of deployed combat troops met criteria for “psychological problems” (i.e., acute stress, depression, or anxiety). Interestingly, the estimated prevalence of “psychological problems” in 2013 (10.0%) was the lowest since 2009.

Most assessments of the behavioral health of veteran and active military members have relied on responses to questionnaires of volunteer participants. However, a recent *MSMR* report summarized numbers, rates, and trends of clinical diagnoses of mental disorders among actively serving U.S. military members overall.³ The report documented that, during each year from 2001 through 2011, 5.5%–9.0% of all active military members received at least one mental disorder-specific diagnosis. Rates of mental disorder diagnoses steadily and markedly increased from 2003 (5.4%) through 2011 (9.0%).

On first consideration, it may seem that estimates of prevalences of mental disorders based on other surveys and studies are inconsistent with the findings of this report. For example, recent studies have generally estimated that 10%–25% of military populations—of various types, in various settings, and at various times—have at least one mental disorder or “psychological problem.” In contrast, this report estimates that, at any given time over the past 13 years, only 1.0% (in 2000) to 3.5% (in 2012) of active component members overall were in treatment for mental disorders. However, the large differences between the findings of this and other reports should be interpreted cautiously.

For example, one would expect prevalences of mental disorders to be higher when based on the self-reported histories of volunteers recruited from active (e.g., Millennium cohort) and veteran (e.g., RAND Corp. study) military populations

than clinical diagnoses of currently serving members of the military services overall. Also, one would expect mental health problems to be more prevalent among members of ground combat units in war zones (e.g., MHAT respondents) and self-selected groups of war veterans (e.g., respondents to study recruitment ads, encouragement of family or friends) than among non-deployed, actively serving members of the military services overall.

In addition, during calendar year 2012, nearly 40% of all service members who received “new” mental disorder diagnoses had no follow-up encounters within 60 days. As such, by the criteria used for this report, nearly 40% of all “treatment courses” consisted of only one encounter and lasted only 1 day. The finding suggests that many of the case defining diagnoses documented on the records used for this report were “rule out” diagnoses (e.g., evaluations for disorders that were not present), behavioral health conditions not requiring medical clinical follow-ups (e.g., normal reactions to stressful life events), or cases lost to clinical follow-up (e.g., non-compliance with scheduled follow-ups, deployments or assignments to new duty locations, medical disability retirements or other terminations of military service). Whatever the reasons, it is noteworthy that although diagnoses of mental disorders consistently increased during the surveillance period, because so many treatment courses were so short, relatively few military members (1.0%–3.5%) were “in treatment” for mental disorders at any given time.

Because so many mental disorders that affect active military members have brief clinical and military operational effects, the numbers of active military members who are in treatment for mental disorders at given times remain relatively low—even if rates of diagnoses of new mental disorders are fairly high. On the other hand, prevalences of mental disorders among veterans of military service may be relatively high, even if rates of new diagnoses among veterans are fairly low. In summary, because the underlying populations are not comparable and the severities and durations of the self-reported and clinically diagnosed disorders of interest likely differ, direct comparisons

of prevalence estimates of other studies and surveys with those of this report are not very informative and potentially very misleading.

In 2006, a Department of Defense task force was commissioned to assess issues related to the mental health of military members. The task force’s main findings were that stigmas related to mental health care were pervasive; mental health professionals were not sufficiently accessible to service members and their families; there were significant gaps in continuity of care; and there were insufficient resources (e.g., funds, personnel) to adequately support the psychological health of service members.^{6,8} At least partly in response to these findings, the Army more than doubled its military and civilian behavioral health workforce over the next 5 years.^{7,9} To a large extent, the findings of this report directly reflect the significant increases in behavioral healthcare providers since 2006.

For example, from 2004 through 2012, the numbers of service members diagnosed with mental disorders steadily increased. However, the numbers of encounters during and the durations of treatment courses remained fairly stable from 2000 through 2005 but then sharply and steadily increased from 2006 through 2011. Thus, from 2006 through 2012, the intensities (e.g., number of encounters) and durations of treatment courses increased much more rapidly than the numbers of individuals diagnosed with new mental disorders. The timing of the increases closely correspond to the increases in behavioral healthcare providers.

The findings of this report should be interpreted with consideration of several significant limitations. For example, the estimation method used for analyses was based on the assumption that most of, and only, military members with clinically significant, socially disruptive, or militarily relevant mental disorders were diagnosed with and treated for those disorders. However, barriers to care (e.g., perceived and de facto stigmas) and limitations to the availability of some clinically indicated mental health services (e.g., inadequate numbers and locations of providers) markedly changed over the period of interest of

this report. In turn, relationships between the numbers of military members in treatment for mental disorders and those with mental disorders for which treatments were indicated undoubtedly changed. As such, increasing proportions of military members in treatment for mental disorders over time reflect not only changes in the incidence of clinically significant mental disorders but also reductions of barriers and improvements in access to clinically indicated care. To the extent that the findings of this report reflect increases in mental health care for those in need, the increasing proportions of military members in treatment for mental disorders over time may portend improvements rather than decrements in the psychological health and military operational capabilities of the force.

Also, it should be acknowledged that, during the period of interest for this report, an unknown but likely large number of service members did not seek care for their mental disorders through the Military Health System. However, because of efforts to reduce stigmas and remove barriers to seeking mental health services, the proportions of affected service members who did seek or were referred (e.g., through mandatory deployment-related screening) for care through the Military Health System likely increased.⁷ As such, the temporal trends documented in this report reflect changes not only in the “true” incidence but also in the ascertainment of clinically significant mental disorders.

Also of note, some case-defining diagnostic codes that were reported in medical records may have documented screening, clinical evaluation (e.g., “rule out” diagnoses), or counselling sessions rather than clinical diagnostic or treatment sessions for case-defining disorders. To the extent that this occurred, the numbers and proportions of individuals diagnosed with and treated for mental disorders in this report overestimate the actual numbers and proportions of those affected and treated.

Additionally, it should be noted that some medical encounters documented with V-codes of the ICD-9-CM coding system were included if the code indicated psychological trauma (e.g., V15.4) or other psychological and physical stress

(V62.x). However, not all V-coded medical encounters related to possible psychosocial and behavioral problems were included in this analysis. Previous *MSMR* analyses have provided a comprehensive overview of the nature and magnitude of other psychosocial problems documented with V-codes not considered in this report (e.g., partner relationship or family circumstances problems).³

Finally, for surveillance purposes, treatment courses were defined by initial mental disorder-specific encounters (i.e., first such encounters within 60 days) and all follow-up encounters that occurred within 60 days of a prior mental disorder-specific encounter. We are unaware of other estimates of the distributions of the numbers of encounters during or durations of mental disorder-specific treatment courses. As such, we had no useful referents for designing the analysis or assessing the results. Obviously, the findings of this analysis would vary if different criteria were used to define the beginnings and ends of treatment courses.

In summary, the findings of this report suggest that, even as the numbers of U.S. military members deployed in war zones and the scopes and intensities of combat activities have decreased, the numbers and proportions of U.S. military members in treatment for mental disorders have continued to increase. If access to care and awareness and concern among military leaders continue to increase, and if stigmas and other barriers to seeking care continue to decrease, then the numbers of military members diagnosed with mental disorders and the proportions of military members in treatment for mental disorders likely will continue to increase, even after warfighting ends.⁷

Of note, despite the increases in active component members in treatment for mental disorders, the estimated proportions of U.S. military members in treatment for mental disorders are much lower than the prevalences of mental disorders estimated in recent surveys. The findings reiterate the continuing needs for further reductions of stigmas associated with seeking or receiving mental health care, removals of barriers to accessing all clinically indicated mental

health services, and increases in behavioral health resources for active military members.⁷ However, even if rates of diagnoses of mental disorders remain high or continue to increase after warfighting ends, it is unlikely that such a large proportion of the force will ever be in treatment for mental disorders that operational capabilities will be significantly degraded.

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U.S. Armed Forces Air Crew: Incident Illness and Injury Diagnoses During the 12 Months Prior to Retirement, 2003–2012

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U.S. Armed Services retirees are eligible for disability compensation for medical illness/injury incurred during their service. This analysis of recently retired U.S. active component air crew/aviation service members from all Services evaluated incident diagnoses among aviation retirees during the 12 months prior to retirement and assessed trends in first-time diagnoses by major diagnostic category and aviation component stratification. Most aviation retirees were in their 40s, Air Force, male, white, and senior officers and warrant officers. Among the study population, 14,191 (88%) of aviation retirees had at least one first-time diagnosis recorded during the 12 months prior to retirement. During 2003–2012, 63.8% of all diagnoses in aviation retirees during the 12 months prior to retirement were new. The highest proportions of new diagnoses were for “other disorders of ear,” “organic sleep disorders,” and “general symptoms.” Among the four subtypes of aviators, general air crew/aircraft crew had the lowest proportion of new diagnoses (60.2%).

Retirees from the U.S. Armed Forces who served honorably are eligible for disability compensation and other benefits if they are afflicted by illness or injury that was caused or aggravated by their service. Accurate identification of illnesses and injuries that cause the most debilitating medical disability in the U.S. Armed Forces can inform possible prevention programs to preserve service members' and retirees' long-term health, and potentially save costs of health care and disability compensation for both the Department of Defense (DoD) and Department of Veterans Affairs (VA). In addition, information about health conditions that are minimally debilitating but still qualify for disability compensation can help guide the revision of VA disability programs.

Military service members in aviation-related occupations comprise a unique population subset in which to study illnesses and injuries of importance to retirees as well as DoD and VA. Although

many U.S. service members desire timely documentation of all service-connected illnesses or injuries to qualify for possible VA disability benefits, members of the aviation community have incentives to defer documentation until shortly before retirement. These incentives are attributable to the fact that aviation-related occupations have more stringent medical standards than most non-aviation occupations. Aviators must demonstrate medical fitness during annual flight physical examinations to remain on flying status and to continue receiving flight incentive pay and bonuses.

The annual flight physical is a more extensive occupational and prevention examination than the age-specific physical examination given to DoD service members at regular intervals. For example, aviators must pass annual tonometric hearing tests (hearing booth) and vision tests, including visual acuity, intraocular pressure, depth perception, and color vision.

Another portion of the flight physical involves responding to a very broad-based health questionnaire to report any medical symptoms or diagnoses of recent onset. Given that many medical illnesses and injuries can temporarily or permanently disqualify someone from flying, aviators may opt to minimize reporting such conditions until 1 year before retirement. At that time, an aviator can be grounded with minimal threat to his or her career or of loss of flight specialty pay/bonuses. Therefore, during the 12 months preceding retirement, there is increased motivation to more accurately document illness and injuries to obtain postponed health care and to safeguard the prospect of future VA disability benefits. Finally, just prior to retirement, like all other service members separating from active duty, an aviator must undergo a medical assessment and physical examination, which involve documentation on DD Form 2697 (Report of Medical Assessment) of all diagnoses for which the service member will seek VA disability compensation.

The *MSMR* previously explored the issue of first-time diagnoses prior to retirement in the overall U.S. Armed Forces population.^{1,2} This retrospective cohort study compared rates of diagnoses of illness and injury in U.S. Armed Forces “pre-retirees” (in the 12–18 months before retirement), “retirement eligibles” (during the last 6 months of the study period among those with at least 20 years of time in service but who remained on active duty), and “retirees” (in the 6 months prior to retirement among the “pre-retirees”). “Retiree” diagnosis rates were 57% higher than “pre-retirees” and 23% higher than “retirement eligibles.”¹ A second, follow-up analysis of first-time-ever diagnoses in U.S. Armed Forces retirees in the 6 months prior to retirement showed that 72% of retirees

had a least one first-time diagnosis prior to retirement, that nine out of 18 of the most frequently diagnosed pre-retiree conditions affected air crew/aviation, and that air crew were more likely than others to be diagnosed with a first-time illness/injury prior to retirement.²

This report estimates the numbers, proportions, and natures of illnesses and injuries that were diagnosed for the first time (compared to 4 years before the pre-retirement period) within 12 months of retirement (pre-retirement period) among service members with aviation-related occupations.

METHODS

The surveillance period was from 1 January 2003 through 31 December 2012. The surveillance population included all individuals with a DoD Primary Occupation Code (DoDPOC) designating them as pilots, navigators, or other air crew who completed at least 20 years of service in the active component of the Army, Navy, Air Force, Marines, or Coast Guard and ended their military service during the surveillance period. Individuals hospitalized within 12 months of retirement were excluded.³

For each retiree, all diagnoses of an illness or injury (ICD-9-CM: 001–999) that were reported during outpatient medical encounters in U.S. military treatment facilities and from purchased care providers within the 12 months immediately prior to their retirement dates (referred to in this report as the “pre-retirement period”) and during the 4 years prior to this period (“4-year period”) were ascertained from records routinely maintained in the Defense Medical Surveillance System. The 12-month interval was chosen because aviators may not lose specialty pay if they report or are diagnosed with an otherwise disqualifying illness or injury during this time frame. A 4-year interval prior to pre-retirement was chosen for comparison to allow for an adequate comparison period time and because accurate Service-wide ICD-9-CM data are available

starting in 1998, allowing for a 10-year data analysis of those who retired during 2003–2012. For each retiree, the first instance of a recorded diagnosis of each illness and injury (ICD-9-CM three-digit level) was included in summaries of medical experiences within each of these two time intervals.

For each retiree, an illness or injury was considered a “previous diagnosis” if the corresponding three-digit ICD-9-CM code was reported on a standardized record of an ambulatory encounter at any time during the “4-year period” preceding the “pre-retirement period.” Illnesses and injuries that were diagnosed during the “pre-retirement period” but had not been diagnosed during the “4-year period” were termed “first-time diagnoses” or “new diagnoses.” Proportions of “previous diagnoses” and “first-time diagnoses” were calculated overall and in various military and demographic subgroups.

RESULTS

Between 2003 and 2012, a total of 16,103 service members with an aviation DoDPOC ended their military service after at least 20 years of creditable active duty (and they had not been hospitalized during their last 12 months of service) (Table 1). Of these individuals, 14,191 (88.1%) had at least one “first-time diagnosis” within 12 months of retirement. Most aviation retirees were 40–49 years old, in the Air Force, male, white, senior officers and warrant officers, and had not deployed during the pre-retirement period. The distribution of military and demographic characteristics among aviation retirees who received at least one “first-time diagnosis” during the “pre-retirement period” did not markedly differ from those characteristics among all aviation retirees.

Among the 16,103 aviators who retired during 2003–2012, there were 110,366 diagnoses recorded during their pre-retirement periods. Of the 20 specific ICD-9-CM codes for illnesses and injuries

most frequently diagnosed during the pre-retirement period, those that affected the greatest proportions of retirees were “disorders of refraction and accommodation” (45.3% of all retirees), “other/unspecified disorders of joint” (32.2%), “other/unspecified disorder of back” (24.8%), “unknown cause of morbidity/mortality” (21.3%), and “disorder of lipid metabolism” (20.5%) (Table 2).

Of all 110,366 diagnoses documented during the pre-retirement period, 70,424 (63.8%) were first-time diagnoses (Table 3). Of the 20 most common diagnoses during the pre-retirement period, the highest proportions of retirees for whom these were first-time diagnoses were for “other disorders of ear (including tinnitus)” (81.1%), “organic sleep disorders (including obstructive sleep apnea)” (81.0%), “general symptoms” (69.2%), “osteoarthritis” (68.6%), and “respiratory symptoms” (67.6%) (Table 2).

When the three-digit code diagnoses were grouped into the 15 major diagnostic categories of the ICD-9-CM system, conditions in the musculoskeletal category were the most numerous of pre-retirement diagnoses overall (n=26,552) and among first-time diagnoses (n=15,406) (Table 3). Other illness and injury categories with high numbers of first-time diagnoses were nervous system/sense organs (including hearing, sleep, and refraction and accommodation disorders) (n=10,829), and ill-defined conditions (n=10,607).

Within aviation retiree subtypes, there was modest variation in the proportion of pre-retirement diagnoses that were documented for the first time. The respective proportions were 65.8% for fighter/bomber pilots, 64.8% for helicopter pilots, 63.0% for mobility pilots, and 60.2% for general air crew and aircraft crew (data not shown). Comparison of the percentages of new diagnoses by aviation retiree subtype revealed that fighter/bomber pilots had higher proportions of musculoskeletal disorders than all other subgroups (51%–74% depending on the specific three-digit ICD-9-CM code diagnosis).

TABLE 1. Demographic and military characteristics of aviation service members who retired with at least 20 years of active service, active component, U.S. Armed Forces, 2003–2012

	Aviation retirees who retired after 20 years of service ^a		Aviation retirees with a “first-time” diagnosis ^b during the 12 months before retirement	
	No.	%	No.	%
Total	16,103	100.0	14,191	100.0
Age				
<40	968	6.0	824	5.8
40–44	7,052	43.8	6,065	42.7
45–49	5,631	35.0	5,038	35.5
50–54	2,101	13.1	1,938	13.7
55–59	290	1.8	268	1.9
60–64	60	0.4	57	0.4
>64	1	0.0	1	0.0
Sex				
Male	15,893	98.7	13,997	98.6
Female	210	1.3	194	1.4
Race/ethnicity				
White, non-Hispanic	14,179	88.1	12,495	88.1
Black, non-Hispanic	521	3.2	461	3.3
Other	1,403	8.7	1,235	8.7
Service				
Army	3,046	18.9	2,744	19.3
Navy	3,467	21.5	3,008	21.2
Air Force	8,187	50.8	7,251	51.1
Marine Corps	1,258	7.8	1,062	7.5
Coast Guard	145	0.9	126	0.9
Rank				
Enlisted (E0–E9)				
≤E6	580	3.6	496	3.5
E7	1,562	9.7	1,378	9.7
E8	415	2.6	366	2.6
E9	193	1.2	173	1.2
Officers (O1–O6)/Chief Warrant Officers (CW4–CW5)				
≤O4/CW4	4,759	29.6	4,159	29.3
O5/CW5	6,245	38.8	5,471	38.6
O6	2,349	14.6	2,148	15.1
Occupation				
General air crew	2,741	17.0	2,410	17.0
Pilots/navigation	9	0.1	3	0.0
Fighter/bomber pilots	2,211	13.7	1,894	13.4
Mobility pilots	3,176	19.7	2,770	19.5
Helicopter pilots	4,599	28.6	4,097	28.9
Aircraft crews	3,367	20.9	3,017	21.3
Deployment within 12 months before retirement				
No	14,066	87.4	12,490	88.0
Yes	2,037	12.7	1,701	12.0

^aAviation retirees who had been hospitalized during the last 12 months of service were excluded.

^bAn outpatient diagnosis (at the three-digit level of the ICD-9-CM) that was not present in an individual's electronic medical record in the 4 years immediately before the pre-retirement period (the final 12 months of service)

This report documents the types, counts, and proportions of first-time injury/illness diagnoses in aviation retirees during the 12 months prior to their retirements during 2003–2012. New diagnoses were common in this cohort, with 88% of retirees having at least one first-time diagnosis. Of the 20 illnesses and injuries most frequently diagnosed during the pre-retirement period, the highest proportions of first-time diagnoses were for “other disorders of ear,” “organic sleep disorders,” “general symptoms,” “osteoarthritis,” and “respiratory symptoms.” When aggregated by ICD-9-CM major diagnostic category, the top categories by overall number of diagnoses (new and previous) were disorders of the musculoskeletal system, nervous system and sense organs, ill-defined conditions, respiratory system, and skin/subcutaneous tissues. These findings correlate with previous *MSMR* reports on retirees.^{2,3} The results are also similar to the VA's report on the most prevalent service-connected disabilities for veterans who began receiving their compensation during fiscal year 2012 with the exception of post-traumatic stress disorder (PTSD) and migraines (both of these diagnoses result in prolonged if not permanent revocation of medical flying clearances).⁴ As reported in the VA Annual Benefits Report to Congress (2012), the most prevalent service-connected disabilities for veterans who began receiving compensation in 2012 were tinnitus, hearing loss, limitation of flexion (knee), PTSD, lumbosacral or cervical strain, scars (general), limitation of motion of the ankle, degenerative arthritis of the spine, migraine, and residuals of foot injury.⁴ According to the same VA Benefits Report, the top five service-connected disabilities by body system for veterans who began receiving compensation in 2012 were the musculoskeletal system, impairment of auditory acuity, skin, neurological conditions, and mental disorders.⁴

The results stratified by aviation designation/subtype showed a few modest trends, but overall they must be interpreted with caution because of the broad range of aviators found in each category. The lower

TABLE 2. Most frequent illness or injury diagnoses recorded among aviation retirees (n=16,103) and proportions that were “first-time” diagnoses during the 12 months before retirement, active component, U.S. Armed Forces, 2003–2012

ICD-9-CM code	Diagnosis	No. of retirees diagnosed during the 12 months before retirement	% of all aviation retirees	No. of retirees with “first-time” diagnoses	% of all diagnoses that were “first-time” diagnoses
367	Disorders refraction/accommodation	7,291	45.3	1,641	22.5
719	Other/unspecified disorders of joint	5,183	32.2	2,415	46.6
724	Other/unspecified disorders of back	3,999	24.8	1,822	45.6
799	Unknown cause morbidity/mortality	3,424	21.3	1,456	42.5
272	Disorders of lipid metabolism	3,296	20.5	1,304	39.6
780	General symptoms	2,837	17.6	1,963	69.2
726	Peripheral enthesopathies	2,665	16.6	1,532	57.5
786	Respiratory symptoms	2,571	16.0	1,738	67.6
729	Other disorders of soft tissues	1,966	12.2	1,268	64.5
389	Hearing loss	1,940	12.1	1,197	61.7
327	Organic sleep disorders	1,930	12.0	1,563	81.0
388	Other disorders of ear	1,843	11.5	1,495	81.1
722	Intervertebral disc disorders	1,832	11.4	976	53.3
401	Essential hypertension	1,808	11.2	704	38.9
723	Other disorders of cervical region	1,701	10.6	1,029	60.5
702	Other dermatoses	1,633	10.1	923	56.5
715	Osteoarthritis	1,572	9.8	1,078	68.6
465	Acute upper respiratory infection	1,570	9.8	697	44.4
477	Allergic rhinitis	1,474	9.2	711	48.2
530	Diseases of esophagus	1,472	9.1	857	58.2

TABLE 3. Diagnoses made among aviation retirees during their last 12 months of service, by major ICD-9-CM diagnostic category, and by previous documentation, active component, U.S. Armed Forces, 2003–2012

Major diagnostic category (ICD-9-CM)	No. of diagnoses among aviation retirees during the 12 months before retirement	No. of diagnoses from the 12 months before retirement that had also been diagnosed during the preceding 4-year period	No. of diagnoses made for the “first time” during the 12 months before retirement	% of “first time” diagnoses during the 12 months before retirement
Musculoskeletal system	26,552	11,146	15,406	58.0
Nervous system/sense organs	19,673	8,844	10,829	55.0
Ill-defined conditions	15,890	5,283	10,607	66.8
Respiratory system	7,568	2,699	4,869	64.3
Skin/subcutaneous tissues	6,591	1,916	4,675	70.9
Injury/poisoning	6,522	1,072	5,450	83.6
Endocrine, nutrition, immunity	5,022	2,652	2,370	47.2
Digestive system	4,996	1,174	3,822	76.5
Circulatory system	4,611	1,756	2,855	61.9
Neoplasms	4,448	1,139	3,309	74.4
Mental disorders	2,758	827	1,931	70.0
Infectious/parasitic diseases	2,467	657	1,810	73.4
Genitourinary system	2,378	614	1,764	74.2
Congenital anomalies	616	113	503	81.7
Blood/blood forming organs	274	50	224	81.8
Total	110,366	39,942	70,424	63.8

proportion of new diagnoses in the combined general air crew and aircraft crew category, compared to fighter/bomber pilots, mobility pilots, and helicopter pilots, is the most difficult to interpret because of the diverse career fields included within this subtype, but it could suggest that pilots (who are not in this category) have a higher proportion of new diagnoses in the 12 months prior to retirement than other non-pilot aviators.

The most striking of the results stratified by aviation subtype is the increased proportion of new diagnoses (12 months prior to retirement) of musculoskeletal disease in the fighter/bomber pilots. The fighter/bomber pilot proportion of new diagnoses of all types of musculoskeletal disease (osteoarthritis, other/unspecified disorders of joint, intervertebral disk disorders, other disorders cervical region, other unspecified disorders of back, and peripheral enthesopathies) found in the top 20 overall diagnoses exceeded that of all other groups. This suggests that fighter/bomber pilots may be at increased risk for musculoskeletal injury, and that improvements to the cockpits and flying techniques might possibly mitigate this risk.

Several limitations to this report should be considered when interpreting the results. DoDPOC aviation designation categories may not accurately capture an aviator's occupation, especially in the general air crew and aircraft crew combined category. Additionally, general and flag officers on flying status were not classified with an aviation DoDPOC and were therefore not captured in this report. The endpoints of analyses were ICD-9-CM diagnostic codes that are indicators of the conditions of interest for this report. However, some of the ICD-9-CM indicator

diagnoses used here, particularly those not recorded as primary (first-listed) diagnoses, may not represent confirmed diagnoses or currently symptomatic disease. In addition, misclassification of a first-time diagnosis may occur if a follow-up appointment used a similar but distinct ICD-9-CM code, if the initial diagnosis occurred before the surveillance period, or if treatment was obtained outside of what is considered purchased care.

In summary, this report is a descriptive analysis of U.S. Armed Forces aviators who retired over a 10-year surveillance period and the data indicating that there was a large number of first-time diagnoses within 12 months before retirement. These first-time diagnoses correlate with the most prevalent 2012 VA service-connected disabilities both in individual diagnoses and diagnostic categories with the exceptions of PTSD, migraines, and mental disorders. The findings suggest that aviators underreport injury and illness symptoms until just prior to retirement; such behaviors can lead to missed or late diagnoses, inaccurate surveillance estimates of the burden of injury and illness, and inadequate prevention programs to reduce morbidity.

The study lends itself to several suggestions for U.S. Armed Forces policy improvement. First, the annual flight physical health assessment questionnaire should be revised (perhaps based on age, aircraft type, or other risk factors) to ask specific yes/no questions (in addition to broad-based questions) to query items of high disease burden (specifically obstructive sleep apnea [OSA]), hearing loss or tinnitus, and musculoskeletal disease) in the 12 months before retirement. This query may lead to better baseline surveillance of disease and allow for

implementation of preventive measures to prevent morbidity. The U.S. Armed Forces could follow the Federal Aviation Administration's lead and use risk factors such as obesity to automatically screen any aviator for OSA if he or she met a certain body mass index criteria.⁵

In addition to modifying the flight physical, modifying the DD Form 2697 for retirement to clarify the true disability incurred by the patient from each listed diagnosis (by documenting time, onset and duration of symptoms, and perceived disability) could help improve the apportionment of disability benefits awarded.

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The Geographic Distribution of Incident Lyme Disease Among Active Component Service Members Stationed in the Continental United States, 2004–2013

Lee Hurt, DrPH, MS; Kerri A. Dorsey, MPH

Lyme disease, first identified in 1976 in a group of school children in Lyme, CT, is now recognized as the most common tick-borne illness in the United States.¹ It is caused by infection with the bacterium *Borrelia burgdorferi* and is acquired through the bite of an infected blacklegged tick (*Ixodes scapularis*) or the western blacklegged tick (*Ixodes pacificus*) in the United States. Symptoms can include a bull's-eye rash (erythema migrans), fever, fatigue, headache, and joint pain. Left untreated, the infection may lead to Bell's palsy, meningitis, arthritis, and cardiac abnormalities.²

Although identified only a few decades ago, the bacteria and the associated human infection are believed to have existed for thousands of years in the United States and Europe. The prevalence of infected ticks in an area can be affected by habitat changes, and can increase with the overpopulation of rodent and deer due to the decrease in their predator population levels. These factors are all ultimately affected by human activities.¹

Military service members may be at increased risk for acquiring Lyme disease, compared to the general population, because their training activities often require that they spend substantial time outdoors, often in or near wooded or grassy areas where infected ticks are endemic. This analysis was developed to identify areas of the continental United States where active component service members are stationed and may be at increased risk for Lyme disease.

METHODS

The Defense Medical Surveillance System was used to identify all active component service members with a diagnosis of Lyme disease during 2004–2013. The

surveillance case definition was defined as anyone having at least one inpatient medical encounter with a diagnosis of Lyme disease (ICD-9-CM code: 088.81) in any diagnostic position, or having at least two outpatient medical encounters occurring within 60 days of each other, with a Lyme disease diagnosis in any diagnostic position, or having a record of a reportable medical event of Lyme disease.³ The incidence date was defined to be the earliest of the inpatient encounters, outpatient encounters, or reportable medical event. An individual was counted as an incident case only once during the study period.

The geographic location of each case was defined as the service member's unit ZIP code at the time of incident diagnosis. Cases with unit ZIP codes outside the continental United States were excluded. Each service member's unit ZIP code usually reflects the ZIP code for the building in which he or she primarily works. However, large military installations often encompass multiple ZIP codes, and personnel may work in varied areas on the base. In an effort to account for this broader exposure area, the three-digit ZIP code, which combines all five-digit ZIP codes that share the same first three digits (and represents collocated ZIP codes), was used to indicate geographic location. The sum of all incident Lyme disease cases was computed for each three-digit ZIP code. Incidence rates were computed by dividing these cases by the sum of the active component person-time in years for each three-digit unit ZIP code.

These rates and associated three-digit unit ZIP codes were loaded into a geographic information system, ArcGIS (Esri, Redlands, CA, USA), and joined to an Esri-provided map of U.S. three-digit ZIP codes. Rates based on fewer than five Lyme disease cases were not shown due to unstable rates.

RESULTS

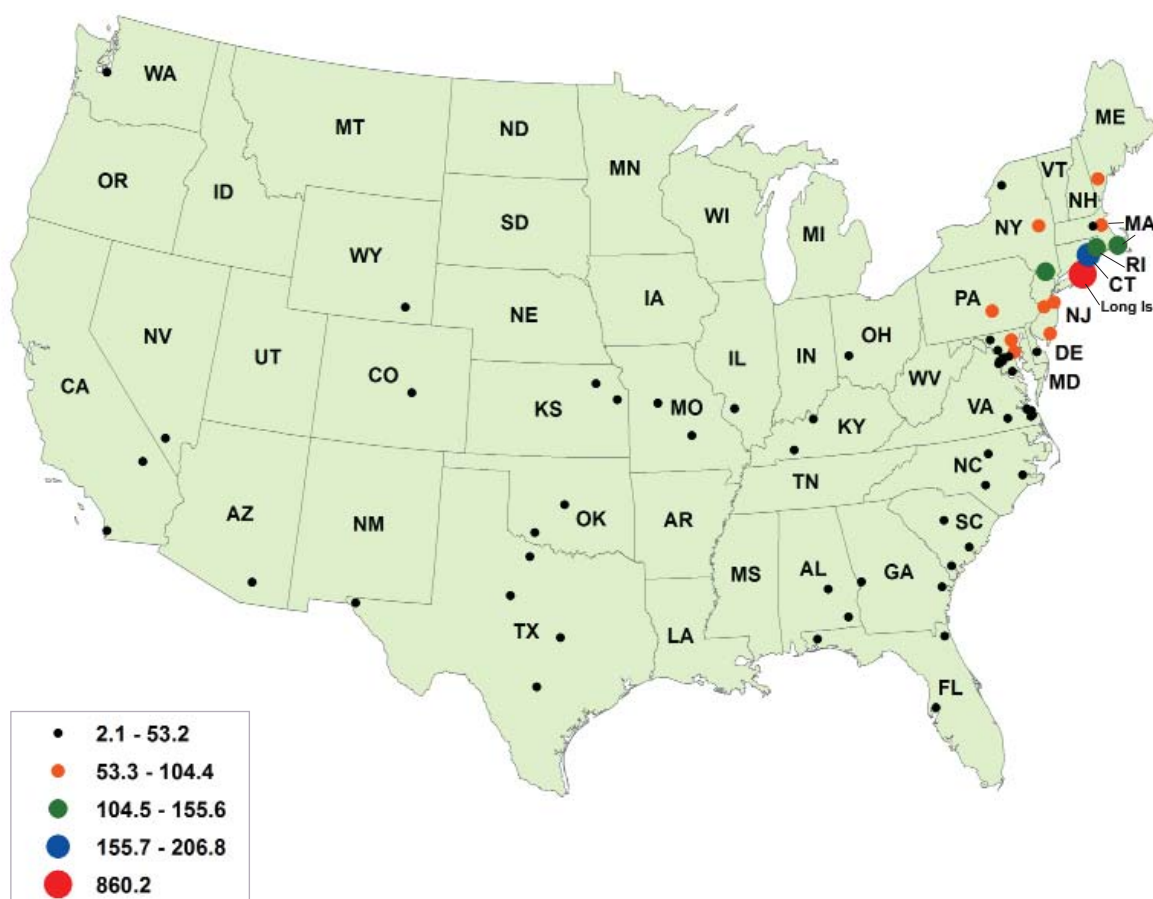
The highest rates of diagnoses of incident Lyme disease among active component service members in the United States were found in the Northeast (**Figure 1**). The highest rate (860 cases per 100,000 person-years [p-yrs]) was found among Coast Guard personnel stationed in Suffolk County, the easternmost county of Long Island, NY. Other high rates were found at the Naval Submarine Base New London, CT (206 cases per 100,000 p-yrs), the U.S. Military Academy at West Point, NY (155 cases per 100,000 p-yrs), two areas with military facilities in Newport, RI (151 and 140 cases per 100,000 p-yrs), and Fort Monmouth, NJ (100 cases per 100,000 p-yrs). There were also clusters of high rates found in the Baltimore, MD–Washington, DC, region and Norfolk, VA, area.

The unit locations with the highest absolute number of incident cases during 2004–2013 were Naval Submarine Base New London, CT (96 cases), Marine Corps Air Station Cherry Point, NC (70 cases), Andrews Air Force Base, MD (44 cases), and Fort Drum, NY (38 cases). The three Coast Guard stations on Long Island in the ZIP code with the highest rate had a total of 13 cases during the study period. However, because only about 150 individuals are stationed there each year, the calculated incidence rate was quite elevated.

EDITORIAL COMMENT

During the 10-year surveillance period, the highest incident rates of Lyme disease among active component military service members stationed in the continental United States occurred among those stationed in units located in the Northeast.

FIGURE 1. Incidence rates^a of Lyme disease among active component service members by unit location,^b 2004–2013



^aRate per 100,000 person-years; rates based on fewer than five cases are not shown.

^bUnit location based on three-digit unit ZIP code

All of the top 20 incidence rates occurred at unit locations in the Northeast. This finding is similar to the highest numbers of reported Lyme disease cases among the general population described by the Centers for Disease Control and Prevention (CDC).⁴ One difference between the active military and general population data is that there were substantial numbers of cases reported by the CDC in Wisconsin and Minnesota, whereas there were no military units in these states identified with five or more incident cases during the study period. This discrepancy is likely attributable to the paucity of active component units in these two states. As a result, the number of active component service members—the population of interest in this analysis—assigned in those states was relatively small.

The CDC reports that the ticks that carry *B. burgdorferi* do not live throughout

the United States. The infected ticks are principally found from Virginia to Maine, in Wisconsin and Minnesota, and on the West Coast.⁵ Figure 1 shows numerous units located outside these regions that had at least five incident cases over the study period. Some of these cases may be attributed to personnel who were bitten by an infected *Ixodes scapularis* or *Ixodes pacificus* tick while visiting or training in endemic areas of the country. Furthermore, it is plausible that some of these diagnosed Lyme cases among service members stationed in the South or Southwest may have actually been cases of Southern tick-associated rash illness (STARI).⁶ STARI can present with a bull's-eye rash, similar to the rash that frequently occurs with Lyme disease.⁵ The erythema migrans rash and accompanying fever, headache, and fatigue are associated with a bite from the lone star tick, *Amblyomma americanum*. However,

a causative infectious agent has not been identified. The range of the lone star tick extends along the Eastern Seaboard of the United States, into the Midwest and South, and down through Texas.^{6,7} The lone star tick is not an effective vector for transmitting *B. burgdorferi* to humans.⁶

The 10 unit locations in the Northeast and Mid-Atlantic regions of the United States with the highest incidence rates (ranging from 68 to 860 cases per 100,000 p-yrs) contrast with the overall active component Lyme disease incidence rate of 16 cases per 100,000 p-yrs among service members at any location within or outside the continental United States in 2011 (the peak overall rate between 2001 and 2012).⁸

The results of this analysis are subject to several limitations. First, the identification of incident cases of disease was based on administrative data of diagnosis codes in patient medical encounter billing data

and from reportable medical events data. Miscodings of those diagnosis codes would bias the results. Second, the data presented in this report represent the locations where active component service members were stationed, not the locations where they may have been bitten. Third, blood tests for Lyme disease may be negative if performed within a few weeks of a tick bite, before antibodies to the infection have developed.⁵ Therefore, true cases of Lyme disease in persons who do not exhibit the erythema migrans rash and who have early, negative blood tests may not be diagnosed with the condition; such cases would not be captured in this analysis and would result in an undercount of the true number of cases of Lyme disease. In areas where *B. burgdorferi*-infected ticks are endemic, the rash is highly indicative of infection. However, in non-endemic areas, there may be overcounting of Lyme disease cases due to the occurrence of STARI cases.

Lyme disease is not limited to the continental United States. Europe and Asia also have regions that are endemic for Lyme disease. However, cases on these continents are primarily due to the *B. afzelii* and *B. garinii* species of *Borrelia*.¹

The high rates of incident Lyme disease cases in the Northeast and Mid-Atlantic regions of the United States indicate that service members stationed or visiting these areas, or in parts of Europe or Asia, need to take precautions to avoid being bitten by ticks carrying *Borrelia*. These precautions include wearing proper clothing treated with 0.5% permethrin, using insect repellent containing 20%–30% DEET (chemical name: *N, N*-diethyl-*m*-toluamide) applied to exposed skin, walking in the center of trails, avoiding wooded and tall vegetation areas, and showering after being outside in endemic areas.^{9,10}

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TICK VECTORS OF PUBLIC HEALTH IMPORTANCE. *Ixodes scapularis* (blacklegged tick or deer tick) and *Ixodes pacificus* (western blacklegged tick) are the primary vectors of Lyme disease. *Amblyomma americanum* (lone star tick) is a vector for ehrlichiosis, tularemia, and Southern tick-associated rash illness or “STARI.”

Ixodes scapularis (blacklegged tick or deer tick)



CDC/James Gathany

Ixodes pacificus (western blacklegged tick)



CDC/James Gathany

Amblyomma americanum (lone star tick)



CDC/James Gathany

Injuries Associated with Combat Sports, Active Component, U.S. Armed Forces, 2010–2013

The practice of combat sports creates a potential for training- and sports-related injuries among military members. During the 4-year surveillance period, there were 12,108 cases of injuries associated with combat sports among active component service members; the overall incidence rate was 21.0 per 10,000 person-years (p-yrs). The rates were higher among service members who were male, Hispanic, in the youngest age groups, in the Army, junior enlisted, and in combat-specific occupations. The rate among recruit/trainees (779.4 per 10,000 p-yrs) was more than 165 times the rate among all other active component service members (non-recruits) (4.7 per 10,000 p-yrs). Sprains, strains, and contusions accounted for more than one-half of the primary (first-listed) diagnoses associated with combat sports cases. More serious conditions such as concussions/head injuries and skull/face fractures/intracranial injuries were reported among 3.9% and 2.1% of all cases and were more common among boxing-related cases. Hand/wrist fractures were also common among boxing cases. Wrestling had comparatively greater proportions of dislocations and open wounds. Although combat sport training provides many physical and mental benefits to the individual, safety practices should be enforced to reduce the most frequent and serious injuries.

To enhance combat readiness and reinforce the warrior ethos, U.S. military members are trained to fight within close physical range, either empty-handed or with weapons that cannot be fired (i.e., hand-to-hand combat or combatives training). Hand-to-hand fighting skills are introduced during basic recruit training so that all service members, regardless of occupation, rank, age, or sex, have the capability to attack or defend themselves without a firearm in battle.^{1–6} Training often continues both in garrison and while deployed to maintain and develop skills. The current hand-to-hand combat curricula is known as the Modern Army Combatives Program,^{1–3} and was formally implemented by the Army in 2005 and was adopted by the U.S. Air Force in 2008 (Air Force Combatives Program).^{3–4} The Marine Corps Martial Arts Program (MCMAP) was established in 2001 to train Marines and Navy personnel attached to Marine units.^{5–6}

All programs teach a mix of self-defense, martial art techniques (e.g., striking and grappling), realistic situational training, and mental preparedness to promote courage, confidence, control, and enhanced situational awareness, particularly in the battlefield setting. MCMAP's colored belt achievement system encourages continued skill development, and Service-sponsored boxing, wrestling, and combatives programs and tournaments offer male and female service members opportunities to exercise and compete outside of required military training. In addition, service members may participate in non-military organized boxing, wrestling, and combat sports while off duty.

The practice of combat sports (specifically, boxing, wrestling, and mixed martial arts) is inherently physical and creates a potential for training- and sports-related injuries among military members. This report describes the nature and estimates the frequencies

of accidental injuries from combat sports that resulted in medical encounters of U.S. service members since 2010.

METHODS

The surveillance period was 1 January 2010 through 31 December 2013. The surveillance population included service members who served in the active component of the Army, Navy, Air Force, Marine Corps, and Coast Guard during the surveillance period. E-codes (supplemental ICD-9-CM codes used to capture the external cause of injury) and North Atlantic Treaty Organization Standardization Agreement (STANAG) causative agent codes were used to identify cases with medical encounters related to boxing (E008.0; STANAG 203, 223), wrestling (E008.1), martial arts (E008.4), or unspecified combat sport (STANAG 216 [wrestling, judo], 236 [wrestling, judo, or unarmed combat training]). An individual was considered a case if he or she had an inpatient or outpatient encounter with an E-code or an inpatient encounter with a STANAG code in any diagnostic position. The E-codes for boxing, wrestling, and martial arts were new additions to the ICD-9-CM, effective October 1, 2009. An individual could be considered a case once every 90-day period.

Diagnoses associated with deployment were derived from records of medical encounters of service members deployed to Southwest Asia/Middle East that were documented in the Theater Medical Data Store (TMDS). Dispositions from medical encounters were not available from TMDS records and are included in the analysis in the “unknown” disposition category.

RESULTS

During the 4-year surveillance period, there were 12,108 cases of injuries associated with combat sports among active

TABLE 1. Incident counts and incidence rates of injuries associated with combat sports, active component, U.S. Armed Forces, 2010–2013

	No.	Rate ^a
Total	12,108	21.0
Sex		
Male	10,779	21.9
Female	1,329	15.9
Race/ethnicity		
White, non-Hispanic	7,723	21.5
Black, non-Hispanic	1,761	19.3
Hispanic	1,563	24.1
Asian/Pacific Islander	538	23.5
Other/unknown	523	13.6
Age		
<20	1,350	31.7
20–24	4,702	25.0
25–29	3,070	22.2
30–34	1,571	18.0
35–39	875	13.6
40+	540	9.6
Service		
Army	9,168	41.6
Navy	530	4.1
Air Force	884	6.7
Marine Corps	1,461	18.4
Coast Guard	65	3.9
Status		
Recruit/trainees	9,470	779.4
Active duty (non-recruit)	2,638	4.7
Rank		
Junior enlisted	7,365	29.3
Senior enlisted	3,347	14.8
Junior officer	1,131	18.8
Senior officer	265	7.0
Occupation		
Combat-specific	2,827	35.2
Armor/motor transport	578	25.2
Repair/engineering	2,559	15.4
Communications/intelligence	2,517	20.1
Health care	1,016	20.9
Other	2,611	19.6

^aper 10,000 person-years

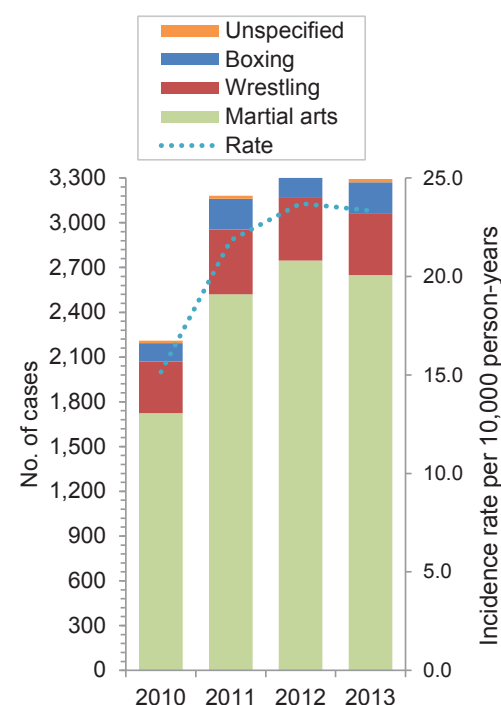
component service members; the overall incidence rate was 21.0 per 10,000 person-years (p-yrs) (Table 1). The rates were higher among service members who were male, Hispanic, in the youngest age groups (i.e., those younger than 30 years of age), in the Army, junior enlisted, and in combat-specific occupations. The rate among recruit/trainees (779.4 per 10,000 p-yrs) was more than 165 times the rate among all other active component service members (non-recruits) (4.7 per 10,000 p-yrs).

Most cases were identified from outpatient encounters (n=11,977; 98.9%)

and a small number were identified in the deployed setting (n=21) (data not shown). Of those cases identified outside of the deployed setting (n=12,087), 79.6% were injuries associated with martial arts, 13.3% with wrestling, 6.3% with boxing, and 0.6% with unspecified activities (Figure 1). The incidence rate increased from 2010 to 2012, and then remained relatively stable in 2013.

Among the 139 hospitalized cases, 89.9% had a discharge disposition of “returned to duty;” the remainder were either transferred to another medical facility (8.6%) or had other/unknown

FIGURE 1. Incident cases and incidence rates of injuries associated with combat sports, active component, U.S. Armed Forces, 2010–2013



dispositions (1.4%) (data not shown). Among outpatient cases (n=11,969), 57.5% were released without limitation; 32.6% were released with work/duty limitation; 4.7% were released to home/quarters; 1.7% were referred or admitted to the hospital; and 3.6% had other/unknown dispositions.

Sprains/strains and contusions accounted for more than one-half (36.1% and 14.9%, respectively) of the primary (first-listed) diagnoses associated with combat sports cases (Table 2). More serious conditions such as concussions/head injuries and skull/face fractures/intracranial injuries were reported among 3.9% and 2.1% of all cases and were more common among boxing-related cases (6.4% and 7.6%, respectively), compared to the other sport types. Boxing also had a greater percentage of “other fractures” (19.8%) (Table 2); hand/wrist fractures accounted for 88.7% of other fractures among boxing cases (data not shown). Wrestling had comparatively greater proportions of dislocations (6.2%; mostly shoulder/clavicle dislocations) and open wounds (6.7%; mostly to the forehead, lip, and scalp).

TABLE 2. Primary (first-listed) diagnoses of medical encounters associated with combat sports, active component, U.S. Armed Forces, 2010–2013

	Total		Wrestling		Boxing		Martial arts		Unspecified	
	No.	% total	No.	% total	No.	% total	No.	% total	No.	% total
Sprains/strains (ICD-9:840–848)	4,373	36.1	580	35.8	188	24.6	3,601	37.3	4	5.5
Contusions: (ICD-9:920–924)	1,803	14.9	187	11.5	120	15.7	1,495	15.5	1	1.4
Other/unspecified injuries ^a	1,470	12.1	158	9.7	59	7.7	1,247	12.9	6	8.2
Other fracture (ICD-9:805–829)	1,195	9.9	185	11.4	151	19.8	818	8.5	41	56.2
Arthropathies, dorsopathies, rheumatism (ICD-9:710–729)	935	7.7	120	7.4	38	5.0	777	8.1	0	0.0
Dislocation (ICD-9:830–839)	472	3.9	101	6.2	21	2.8	348	3.6	2	2.7
Concussion, head injury, postconcussion syndrome (ICD-9:850, 959.01, 310.2)	472	3.9	43	2.7	49	6.4	374	3.9	6	8.2
Open wounds: (ICD-9:870–897)	430	3.6	108	6.7	26	3.4	296	3.1	0	0.0
Skull/face fractures, intracranial injury (ICD-9:800-804, 851-854)	251	2.1	36	2.2	58	7.6	148	1.5	9	12.3
Other	707	5.8	103	6.4	53	6.9	547	5.7	4	5.5
Total	12,108	100.0	1,621	100.0	763	100.0	9,651	100.0	73	100.0

^aIncludes internal injuries (ICD-9:860–869), injuries to blood vessels (ICD-9:900–904), nerve or spinal cord injury (ICD-9:950–957), crushing injuries (ICD-9:925–929), and injury, other/unspecified (ICD-9:959 [except unspecified head injury: 959.01])

EDITORIAL COMMENT

Service members are at risk for musculoskeletal injuries due to the physical nature of their training, occupations, and deployments. Specific injuries associated with combat sports are discussed in this report. This report likely underestimates the true number of injuries associated with combat sports and does not distinguish between injuries occurring during training, competition, or while on or off duty. The surveillance case definition relied on E-codes and STANAG codes. E-codes are supplementary codes that are not required and their use depends on the detail of notes taken by the clinician and their interpretation by the coder. STANAG codes are used exclusively by the military health system for hospitalizations; they are also not required. Therefore, many injuries that may have been the direct result of combat sports may not have been captured by this report.

Despite the limitations of the codes used to ascertain all cases, valuable surveillance information can be gleaned from the cases in which the codes were documented. Cases were more common among younger males in the Army and service members in combat-specific occupations. The incidence rate among recruits was also dramatically higher

compared to non-recruits. These findings are not surprising given the increase in physical training during the recruit period and the extensive training continually performed by combat-specific occupations in all services.

A majority of the primary diagnostic positions associated with combat sports injuries were relatively minor (i.e., sprains/strains and contusions). However, combat-related sports, particularly boxing, do carry a risk of severe injuries (e.g., head injuries, fractures, and dislocations), which can cause significant morbidity or long-term sequelae (e.g., hospitalizations, surgical intervention), loss of duty time, and decreased operational effectiveness.

Combat-related sports, specifically hand-to-hand combat training, encourage confidence, mental discipline, and physical fighting skills that service members may need in battlefield situations. However, there are costs inherent to learning and enhancing hand-to-hand combat skills and cultivating the fighting spirit essential to the warrior ethos. Leaders, developers, and instructors of hand-to-hand combat training programs should identify preventable threats to the health and safety of participants; in particular, they should select and enforce practices and equipment to reduce the most frequent and serious injuries. Although the training

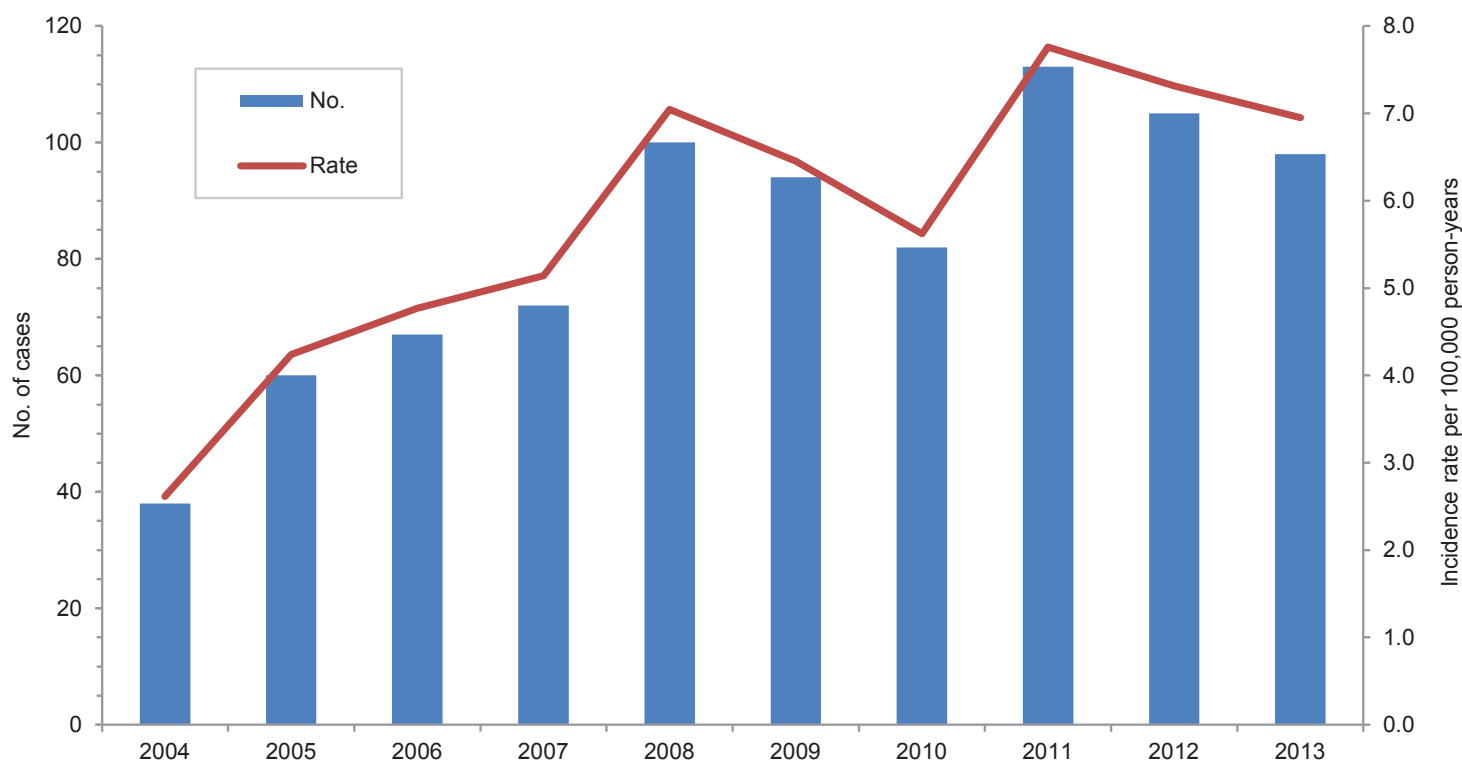
provides many physical and mental benefits to the individual, it should be conducted in as safe a manner as possible.

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Surveillance Snapshot: Cauliflower Ear, Active Component, U.S. Armed Forces, 2004–2013

FIGURE. Incident counts and incidence rates of cauliflower ear, active component, U.S. Armed Forces, 2004–2013

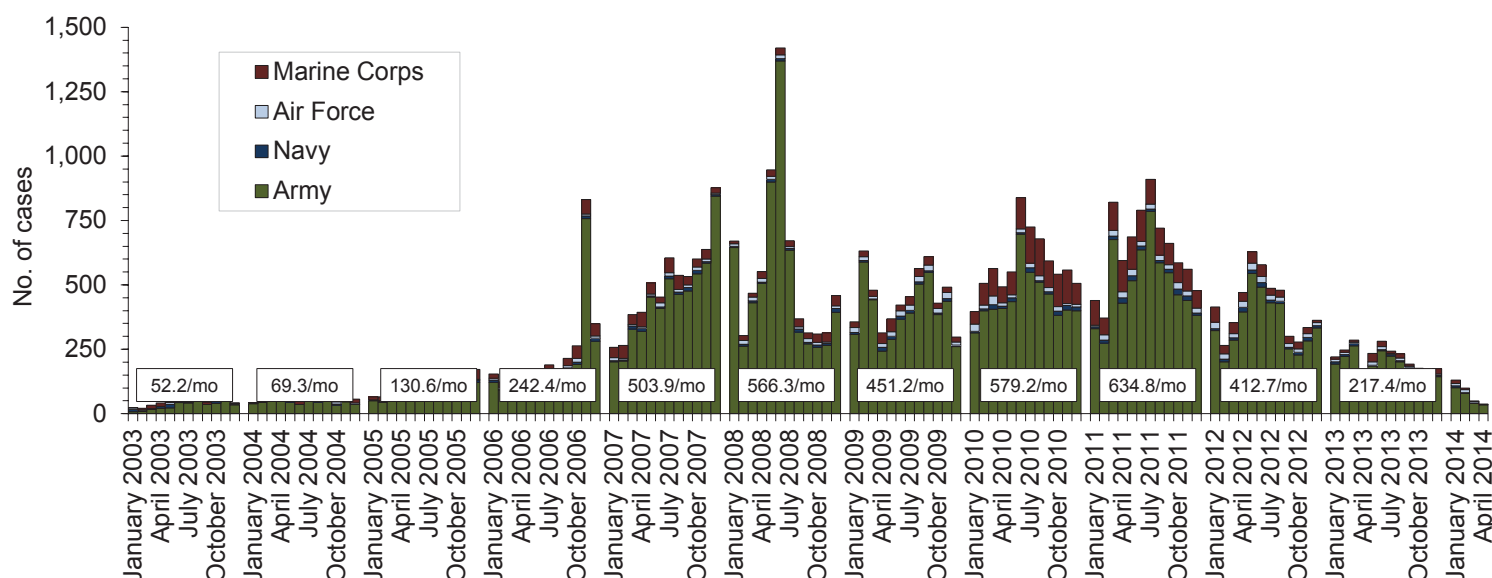


When the external portion of the ear suffers blunt trauma, fluid or blood clots can collect under the perichondrium of the ear (the layer of tissue between the cartilage and the skin) and cause the cartilage to separate from the overlying perichondrium. As the injury heals, fibrous tissue can form and fluid can build up and cause abnormal shaping and coloring of the ear, producing a deformity referred to as cauliflower ear. Cauliflower ear is common among individuals who engage in contact sports such as wrestling, boxing, and mixed martial arts. Service members regularly engage in sports and combat training and may be at risk of damage to their ears during such activities. Wearing protective head gear and, in the event of ear trauma, prompt medical drainage of accumulating blood or other fluids can reduce the risk of this deformity.

During 2004–2013, a total of 829 service members were diagnosed with cauliflower ear (ICD-9-CM code: 738.7); the incidence rate was 5.8 per 100,000 person-years (**Figure**). The incidence rate increased 166% during the 10-year surveillance period. Incidence rates were higher among service members who were male, Asian/Pacific Islander race/ethnicity, in their 20s, in the Marine Corps, recruits, and in combat-specific occupations (**data not shown**).

Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–April 2014 (data as of 20 May 2014)

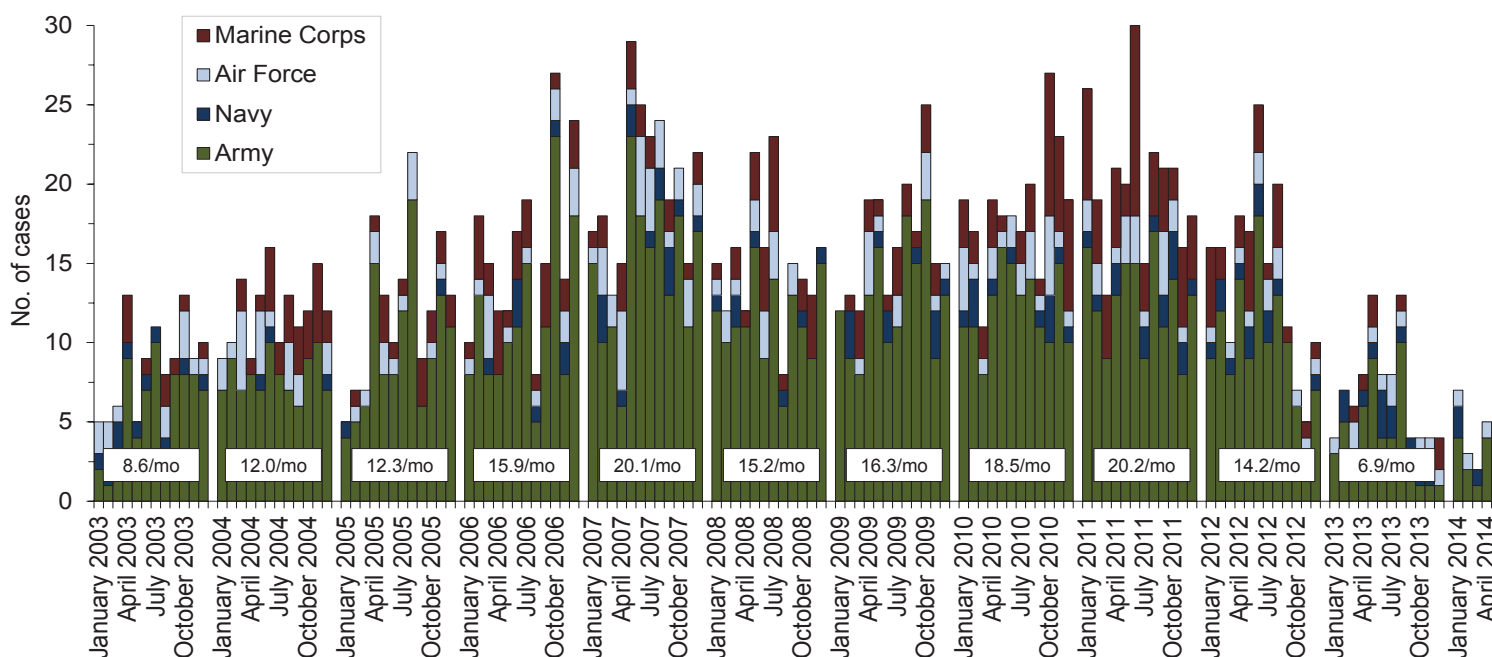
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.52_0-9, V15.52_A-F, V15.59_1-9, V15.59_A-F)^a



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

^aIndicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from OEF/OIF/OND. (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 4,470 deployers who had at least one TBI-related medical encounter any time prior to OEF/OIF/OND).

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

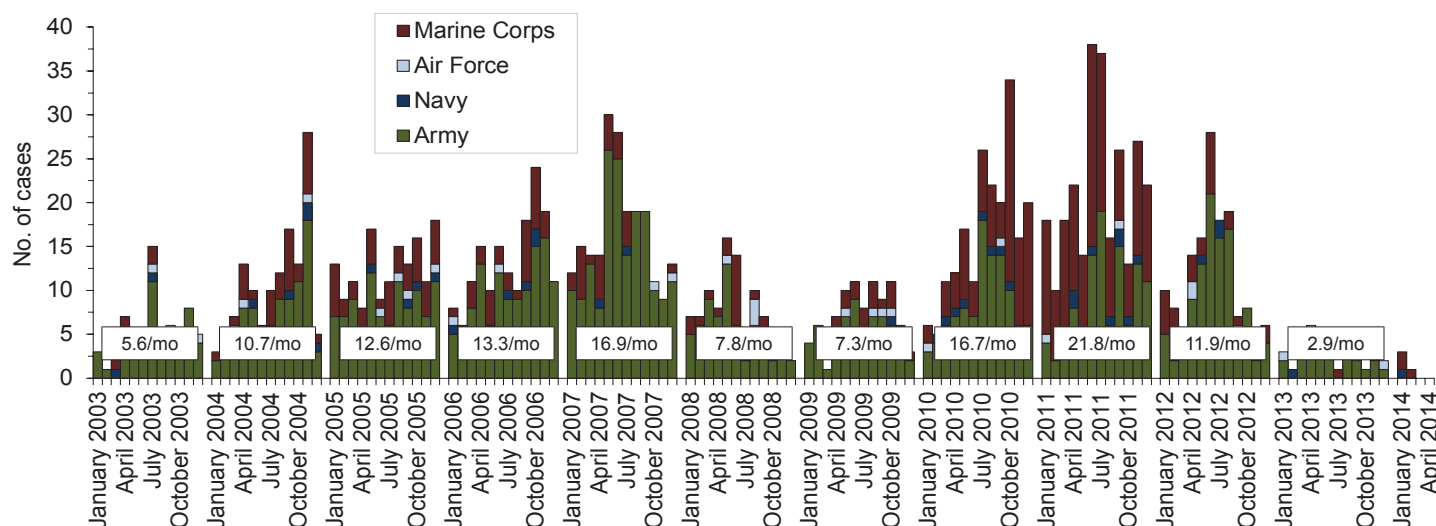


Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-383.

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

Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–April 2014 (data as of 20 May 2014)

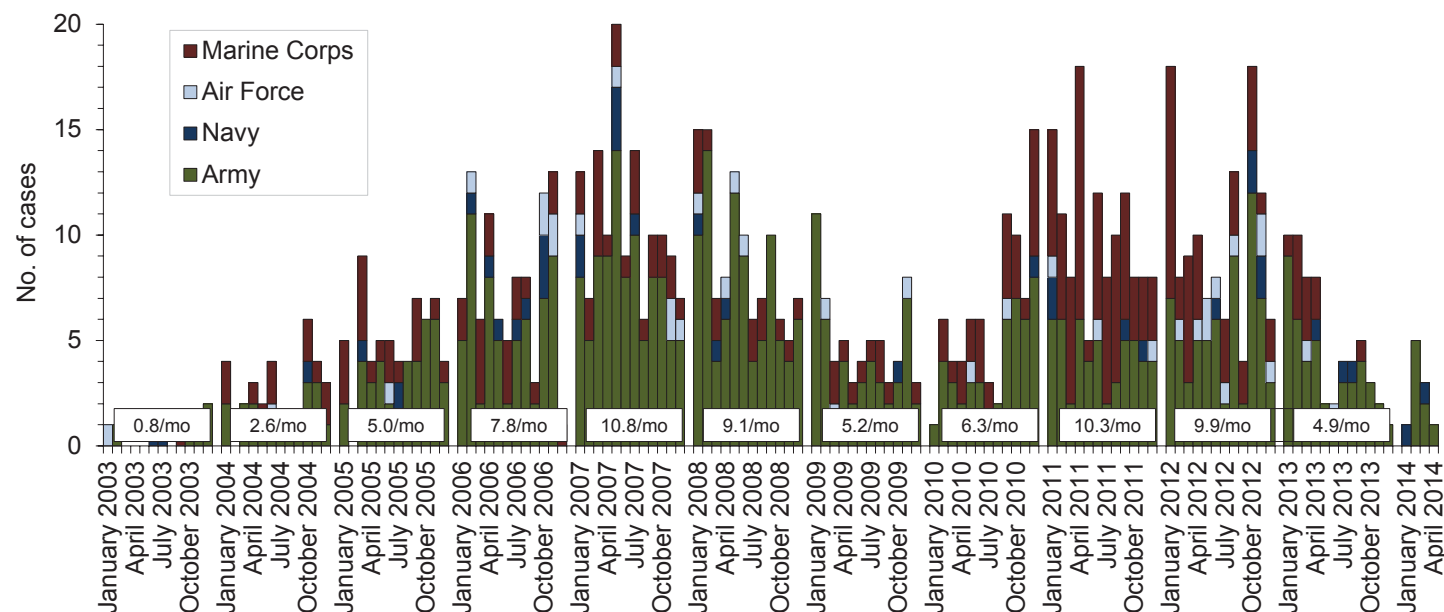
Amputations (ICD-9-CM: 887, 896, 897, V49.6 except V49.61-V49.62, V49.7 except V49.71-V49.72, PR 84.0-PR 84.1, except PR 84.01-PR 84.02 and PR 84.11)^a



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: amputations. Amputations of lower and upper extremities, U.S. Armed Forces, 1990-2004. *MSMR*. Jan 2005;11(1):2-6.

^aIndicator diagnosis (one per individual) during a hospitalization while deployed to/within 365 days of returning from OEF/OIF/OND.

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

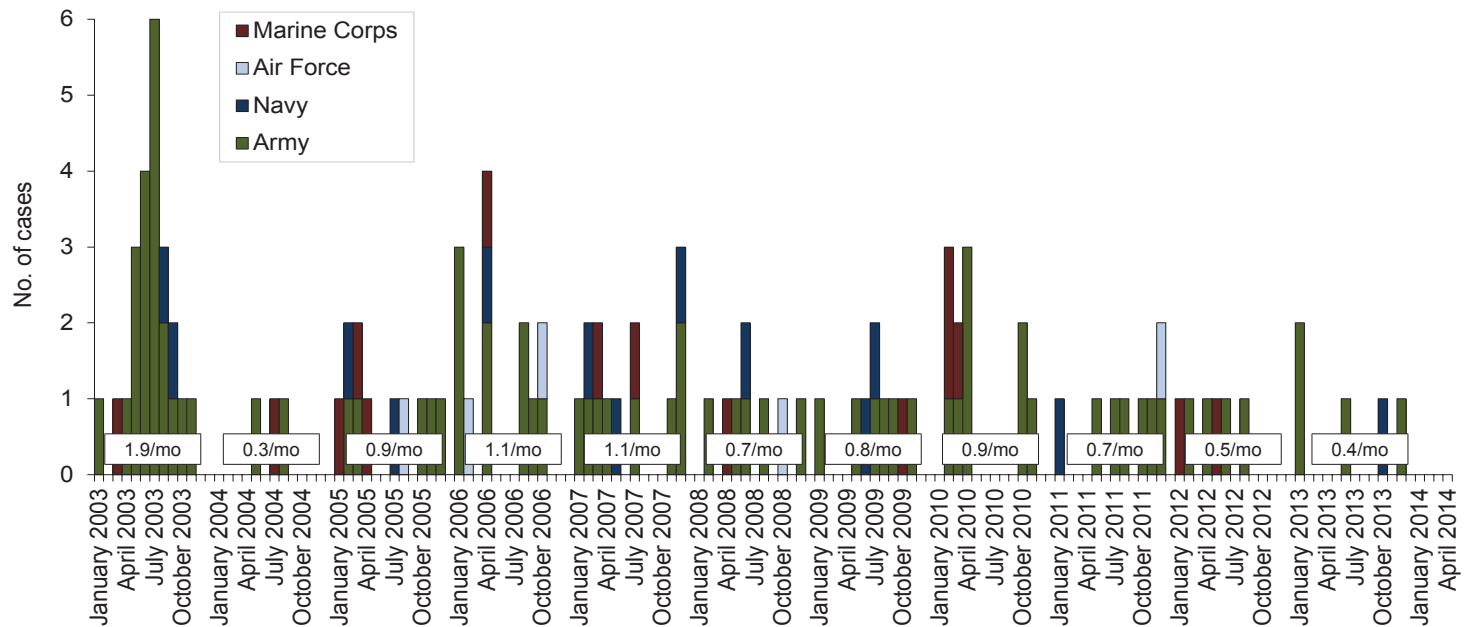


Reference: Army Medical Surveillance Activity. Heterotopic ossification, active components, U.S. Armed Forces, 2002-2007. *MSMR*. Aug 2007; 14(5):7-9.

^bOne diagnosis during a hospitalization or two or more ambulatory visits at least 7 days apart (one case per individual) while deployed to/within 365 days of returning from OEF/OIF/OND.

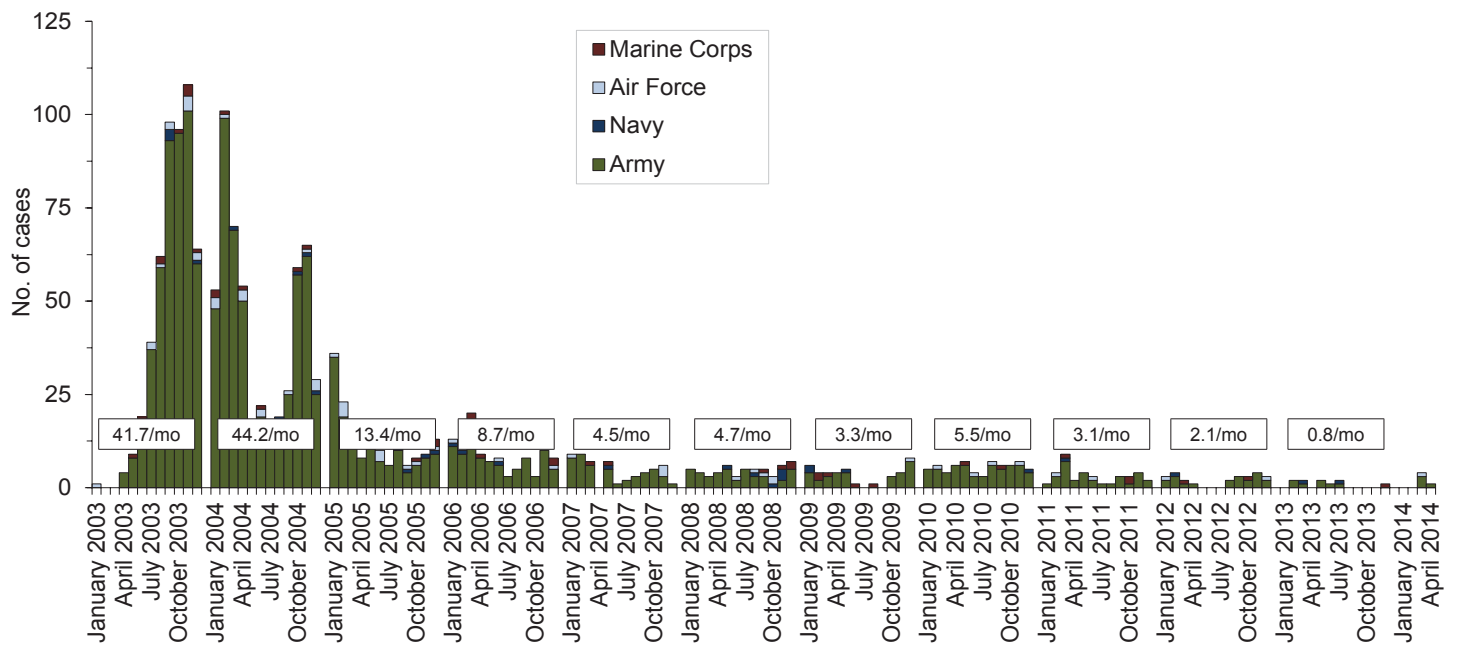
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–April 2014 (data as of 20 May 2014)

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



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: severe acute pneumonia. Hospitalizations for acute respiratory failure (ARF)/acute respiratory distress syndrome (ARDS) among participants in Operation Enduring Freedom/Operation Iraqi Freedom, active components, U.S. Armed Forces, January 2003–November 2004. MSMR. Nov/Dec 2004;10(6):6-7.
^aIndicator diagnosis (one per individual) during a hospitalization while deployed to/within 30 days of returning from OEF/OIF/OND.

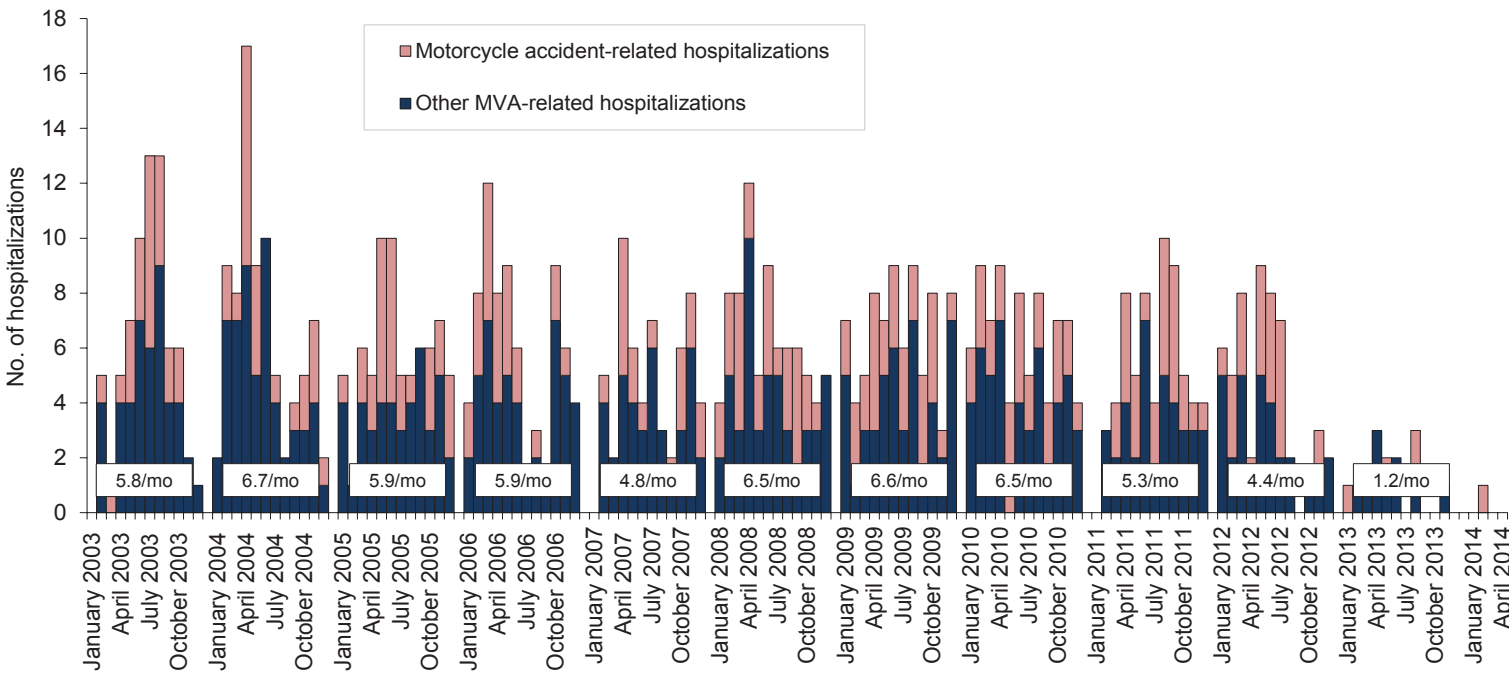
Leishmaniasis (ICD-9: 085.0 to 085.9)^b



Reference: Army Medical Surveillance Activity. Deployment-related condition of special surveillance interest: leishmaniasis. Leishmaniasis among U.S. Armed Forces, January 2003–November 2004. MSMR. Nov/Dec 2004;10(6):2-4.
^bIndicator diagnosis (one per individual) during a hospitalization, ambulatory visit, and/or from a notifiable medical event during/after service in OEF/OIF/OND.

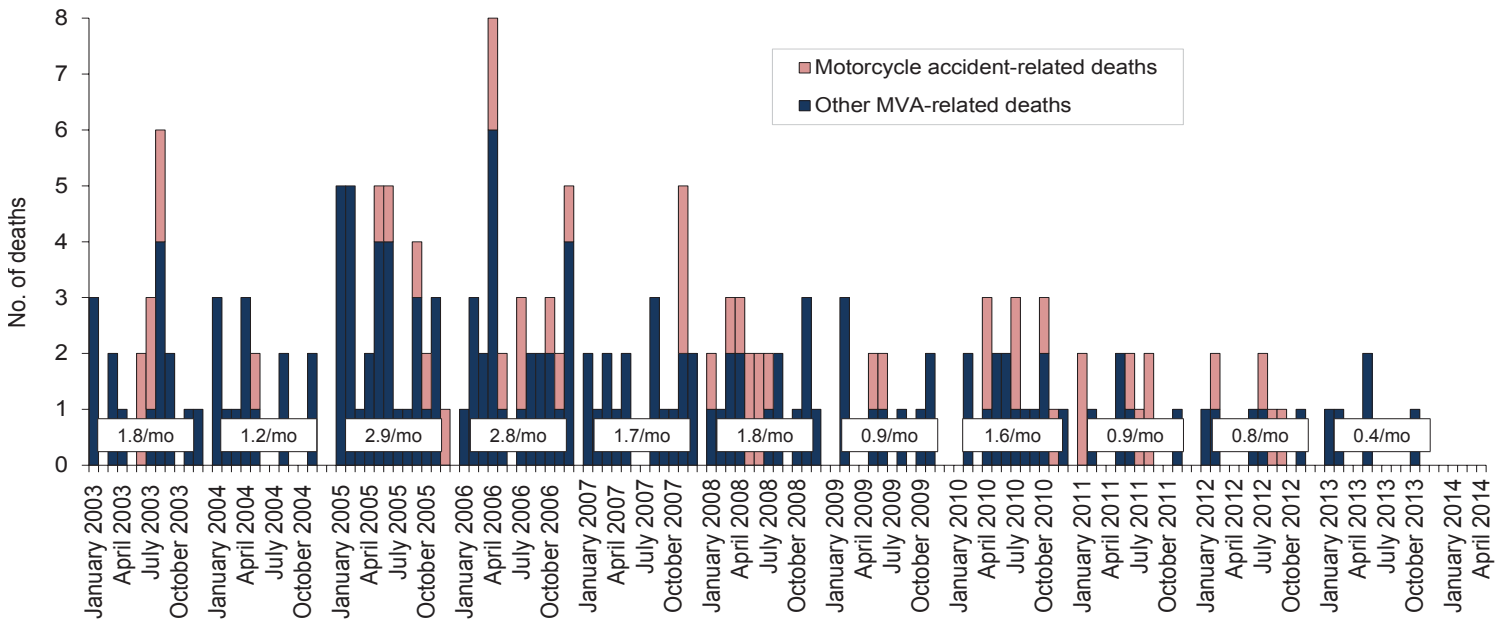
Deployment-related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003–April 2014 (data as of 19 May 2014)

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



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

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



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

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