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# Syncope Among U.S. Air Force Basic Military Trainees, August 2012-July 2013

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Syncope is a common event with many possible etiologies, ranging from benign to severe. Syncopal episodes of any origin, however, may result in traumatic injury due to postural collapse. Based on the prevalence of internal and external stressors during training, basic military trainees may be at increased risk for syncope. Between 1 August 2012 and 31 July 2013, there were 112 unique individuals who experienced syncopal or pre-syncopal events among basic military trainees at Joint Base San Antonio-Lackland, Texas, the only basic training site in the U.S. Air Force. The overall rate was 19.6 cases per 1,000 person-years (18.4 and 36.1 per 1,000 person-years in males and females, respectively). Based upon the findings of electronic chart review of the 112 cases, a majority of events occurred either during or immediately after exercise (n=38) or during a blood draw, immunization, or laceration repair (n=22). The most common etiologies were judged to be neurocardiogenic (n=54) and orthostatic hypotension (n=40), and two cases were attributed to cardiovascular disease. These findings support current preventive measures, including anemia screening during medical in-processing, an emphasis on hydration throughout training, and a padded floor in the trainee vaccination bay.

Syncope is a transient loss of consciousness due to impaired global cerebral perfusion. This hypoperfusion can be traced to a number of factors, broadly categorized into three etiologic classes: reflex-mediated; orthostatic; and cardiovascular.[1] The first category – which represents the largest fraction of cases among individuals of all ages – can be further subdivided into neurocardiogenic syncope, situational syncope (e.g., during urination), and carotid sinus hypersensitivity.[2] Nonetheless, in order to rule out cardiovascular disease as the underlying cause, the evaluations of patients who have experienced syncope often include electrocardiograms, echocardiograms, and 24-hour Holter monitoring[1,3] – costly diagnostics in terms of dollars spent and, for military trainees, training time interrupted.

A pre-syncopal state, characterized by lightheadedness, diaphoresis, nausea, and blurred vision without loss of consciousness, precedes some, but not all episodes of syncope. During pre-syncope, the individual or nearby witnesses may be able to prevent injury by preparing for postural collapse. Even in the presence of witnesses, distinguishing between syncope and pre-syncope may be difficult; moreover, given their similar etiologies, the two conditions often prompt the same kind of diagnostic evaluation.[3]

Over a third of individuals will experience a syncopal event at some point in their lives, with a peak incidence of first cases occurring between the ages of 10 and 35 years.[4] Between 1998 and 2012, the crude incidence rate of syncope among active component members of the U.S. Armed Forces was 7.2 per 1,000 person-years (p-yrs). Rates were higher among females and highest in those aged <20 years. Among males and females in this age cohort, respective rates were approximately 13 and 40 per 1,000 p-yrs. Immunizations were found to be a major trigger of events among young, newly enlisted personnel, and incidence of postvaccination syncope was correlated to the number of immunizations delivered.[5]

Documented civilian rates are lower. The Framingham Offspring study found rates of 2.6 and 4.7 per 1,000 p-yrs for males and females, respectively, between the ages of 20 and 29 years.[6] In younger individuals, prominent syncopal triggers are warm environments (31% of events), prolonged standing (27%), pain (25%), illness (18%), alcohol (13%), emotion (11%), and venipuncture/seeing blood (10%).[7]

This report summarizes counts, rates, etiologies, and surrounding circumstances for syncopal and pre-syncopal events among U.S. Air Force basic military trainees over a one-year surveillance period.

## METHODS

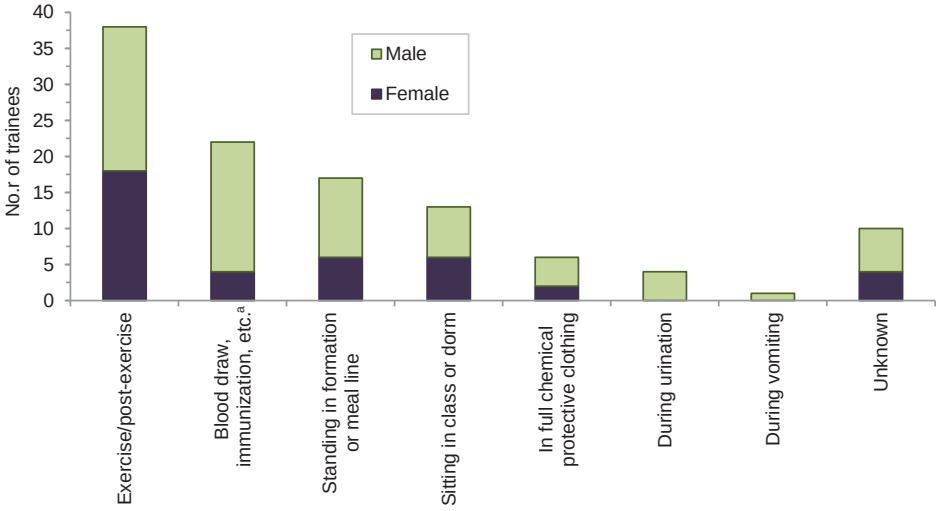
Cases of syncope and pre-syncope were ascertained from the Joint Base San Antonio (JBSA)-Lackland disease and non-battle injury database, which synthesizes diagnoses made in the electronic health record during all trainee medical encounters with demographic information from the basic military training (BMT) personnel file. The database was queried for International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) diagnostic code 780.2 ("syncope and collapse") to identify cases. A trainee could be a case only once during the surveillance period of 1 August 2012 through 31 July 2013.

For all cases identified by this query, retrospective electronic chart reviews were performed to determine the circumstances surrounding the event, the week of training (WOT) in which it occurred, comorbid conditions diagnosed and laboratory values found during the workup (specifically hemoglobin, glucose, and electrolyte levels), whether or not an injury was sustained, and whether or not the event prompted military separation (i.e., entry level separation or medical evaluation board). In accordance with standard reference values, anemia was defined as a hemoglobin concentration of <13.5 g/dL in

males or <12.0 g/dL in females, hypoglycemia as a random glucose concentration of <70 mg/dL at the time of initial evaluation, hyponatremia as <135 mEq/L, and hypokalemia as <3.5 mEq/L.[8] For the sake of more detailed analysis, anemia was further stratified according to hemoglobin concentrations, with different criteria among males and females, as severe (<11.5 g/dL and <10.0 g/dL, respectively), moderate (11.5-12.9 g/dL and 10.0-11.4 g/dL, respectively), and borderline (13.0-13.4 g/dL and 11.5-11.9 g/dL, respectively).

Using denominator data provided by the 737th Training Support Squadron, period prevalence rates were calculated, where period was defined by the 8.5-week BMT session. It was assumed that all trainees completed exactly 8.5 weeks of training (i.e., no attrition and no prolonged training).

**FIGURE 1.** Syncopal and pre-syncopal events by circumstances and gender, U.S. Air Force Basic Military Trainees, August 2012-July 2013




[a]One of the syncopal events occurred during a laceration repair

## RESULTS

Among the 34,791 basic military trainees at JBSA-Lackland between 1 August 2012 and 31 July 2013, there were 112 cases of syncope or pre-syncope, for a period prevalence of 3.2 per 1,000 trainees (3.0 per 1,000 male trainees and 5.9 per 1,000 female trainees). Under the assumptions outlined above, the overall incidence rate was 19.6 per 1,000 p-yrs, and the rates for males and females were 18.4 and 36.1 per 1,000 p-yrs, respectively. Thirty-one cases (28%) were specifically classified by the health care provider as pre-syncope; the remaining 81 cases were either classified as syncope or were not further distinguished in the patients' medical records. The majority of events occurred either during or immediately after exercise (n=38) or during a blood draw, immunization, or laceration repair (n=22). Seventeen events (15%) occurred while the trainee was standing in formation or in a meal line **(Figure 1)**.

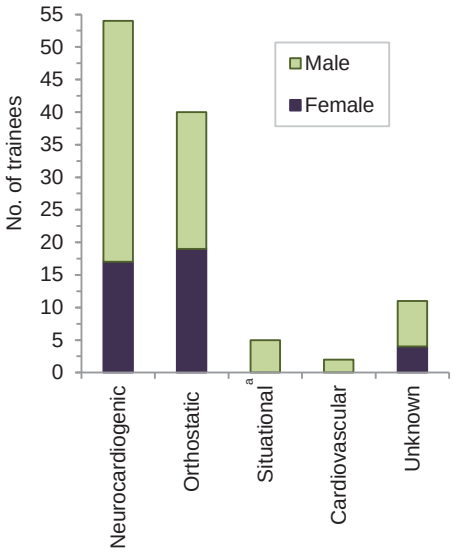
Based upon either the etiology assigned by the provider or the investigators' best clinical judgment during chart review, the most frequent etiologies were determined to be neurocardiogenic (n=54) and orthostatic hypotension (n=40); two cases were attributed to cardiovascular disease **(Figure 2)**.

Syncopal events occurred throughout the 8.5 weeks of training **(Figure 3)**. Early in training (0 WOT and 1 WOT), the majority of events were due to either blood draw/immunizations or exercise. The secondary peak during the sixth week of training ("BEAST week") was likely associated with the use of Mission Oriented Protective Posture (MOPP) gear. Two cases during WOT 7 were attributed to blood donation.

In terms of contributing factors, 26 trainees were diagnosed with comorbid conditions during their syncope evaluations. These conditions included clinical psychiatric diagnoses (n=9), unexplained leukocytosis (n=5), upper respiratory infections (n=5), acute gastroenteritis (n=2), cardiovascular disease (n=2), pneumonia (n=1), urinary tract infection (n=1), and hypothyroidism (n=1). Of those with cardiovascular disease, one had significant coronary heart disease and the other had long QT syndrome with anomalous venous return. Twenty-three trainees were anemic, representing 38 percent of those tested (52 trainees with syncope did not have a hemoglobin measurement). Of those with moderate (n=11) or severe (n=2) anemia, six had syncopal events during or immediately after exercise and three while in formation. Among trainees who had a metabolic panel, three (7%) were hypoglycemic, four (9%) were hypokalemic, two (4%) were hyponatremic, and one (2%) was both hypokalemic and hyponatremic. Four trainees (3.6%) sustained lacerations during syncopal collapse, requiring repair with sutures.

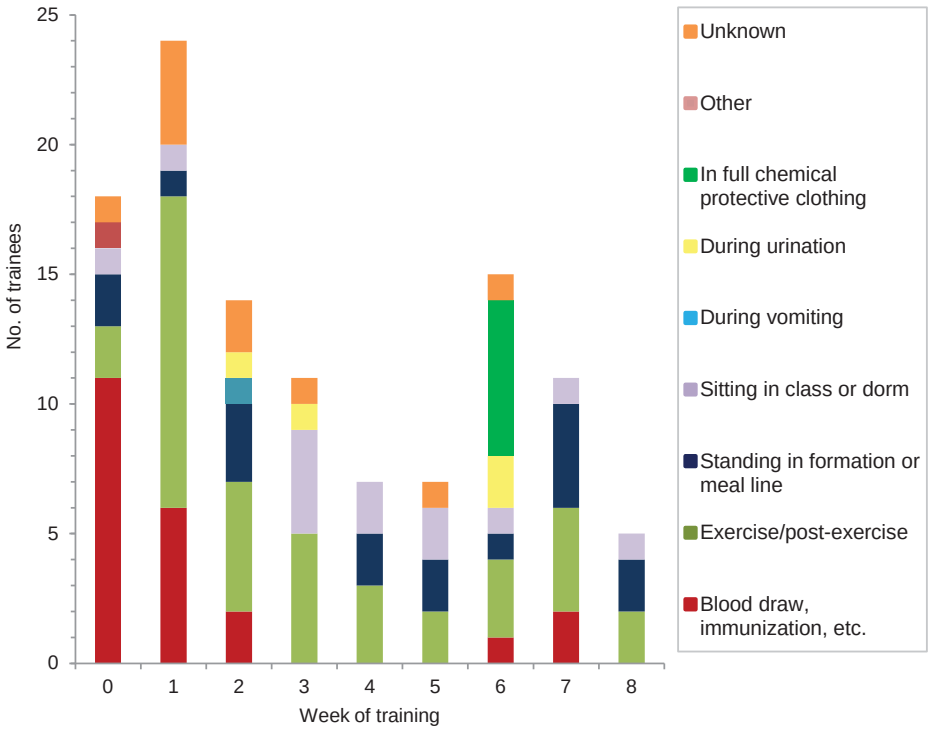
Fourteen trainees began the military separation process shortly after their syncopal events. Of these, seven (50%) were

**FIGURE 2.** Syncopal and pre-syncopal events by etiology and gender, U.S. Air Force Basic Military Trainees, August 2012-July 2013




[a]The five situational causes of syncope were urination (n=4) and vomiting (n=1).

**FIGURE 3.** Syncopal and pre-syncopal events by circumstance and week of training, U.S. Air Force Basic Military Trainees, August 2012-July 2013




given a clinical psychiatric diagnosis during their evaluations.

## EDITORIAL COMMENT

By virtue of their diverse etiologies and potential for causing secondary injuries, syncope and pre-syncope comprise a complex and serious challenge to preventive medicine in the military trainee environment. In a one-year time span at JBSA-Lackland, 112 U.S. Air Force basic military trainees experienced syncopal or pre-syncopal events. The sex-specific rates of 18.4 (males) and 36.1 (females) per 1,000 person-years approximate the corresponding rates of 13 and 40 among active component U.S. military members from 1998 through 2012,[5] but vastly exceed the rates of 2.6 and 4.7 in a similarly aged civilian population.[6] The difference likely reflects the greater density of syncopal risk factors encountered during U.S. Air Force basic military training, among which are warm environments, dehydration, prolonged standing, stress, illness, immunizations, and venipuncture.[5,7] In addition to these known risk factors, this analysis identified anemia – both upon entrance to basic military training and as a result of blood donation – as a potential contributing factor.

As a result of this analysis, the following three recommendations were made to the training command. First, continue the hemoglobin and hematocrit screening during basic military training medical in-processing, which has been in place at JBSA-Lackland since late June 2013, in order to identify and correct anemia to minimize any associated morbidity, such as syncope secondary to orthostatic hypotension.

Second, continue to stress the importance of hydration to training squadron commanders and military training instructors. Additionally, training cadre should encourage all trainees to self-identify if they feel ill and to fall out of physical training or formation at the first signs of pre-syncope. Such pre-emptive actions may prevent injuries sustained during syncopal collapse.

Third, despite the best preventive strategies, some syncopal events, such as neurocardiogenic syncope secondary to blood draws, will continue to occur. Given this likelihood, the goal should be minimization of injuries. In light of the large number of cases during blood draws and immunizations, the floor of the immunization bay should be padded. In 2007, a foam surface was added to the concrete floor of the Trainee Vaccination Center. As a new trainee health center is being built at JBSA-Lackland, a similar floor should be installed in the new immunization bay.

The results of this report should be interpreted in light of its limitations. First, only syncopal and pre-syncopal cases recorded in the electronic health record were included in the analysis. If a trainee experienced a syncopal event in the dorm room and did not seek medical attention, for example, that case would not be included. Second, some providers did not specify etiologies for syncopal events; in these cases, etiologies were determined by best clinical judgment during medical chart review. Third, lab values were not obtained in many cases, so the prevalence of concomitant anemia, hypoglycemia, and electrolyte abnormalities was based on only a subset of cases. Finally, the rates ascertained are for U.S. Air Force basic military trainees, all of whom are trained at JBSA-Lackland, and therefore may not be generalizable to military recruits in the sister services, who experience different training regimens in different geographic locations.

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# Syncope, Active and Reserve Components, U.S. Armed Forces, 1998-2012

During the period of 1 January 1998 to 31 December 2012, the health care records of 153,172 active component service members documented at least one health care encounter with a diagnosis of "syncope and collapse" (overall incidence rate of 7.2 cases per 1,000 person-years). The annual incidence rates rose by 89 percent during the period. During the 15-year surveillance period, there were 4,954 instances of a documented health care encounter with a diagnosis of syncope on the same day that the service member had received an immunization by injection. Annual rates of syncope associated with immunization ranged from a low of 4.4 events per 100,000 immunization episodes in 1998 to a maximum of 14.1 events per 100,000 episodes in 2006. For both syncope diagnoses in general and syncope associated with immunization, rates were higher among women than men and were highest among those under age 20. Nearly ten percent of syncopal events associated with immunization occurred during the first two weeks of military service. Rates of syncope increased with the number of injections received per immunization episode. Diagnoses of physical injury were documented in the records of health care encounters for syncope for 4.0 percent of all syncopal events and 6.9 percent of episodes of syncope linked to immunizations.

Syncope (fainting) is a temporary loss of consciousness due to sudden reduction of blood flow to the brain. Syncope is relatively common, even among young, healthy adults such as military members. Situations that are associated with syncope in members of the U.S. Armed Forces include invasive medical procedures (such as blood donations, other venipunctures, and immunizations), standing for long periods (such as in military formations or waiting lines), and physically demanding training or exercise, especially in hot environments.[1-3] Frequencies and rates of syncope and postvaccination syncope among U.S. military members have been described previously in the *MSMR*,[1,2] and an in depth study among Air Force basic military trainees is reported in this month's *MSMR* (page 2).[3]

The objective of this analysis was to update the estimated frequencies, rates, trends, correlates of risk, and co-occurring conditions for syncope among active component U.S. service members during a recent 15-year period. Additionally, the experiences of active and reserve component members of the U.S. military regarding syncope related to injectable immunizations (postvaccination syncope) are described.

## METHODS

The surveillance period was 1 January 1998 to 31 December 2012. For surveillance purposes, cases of syncope were identified from medical records of inpatient and outpatient encounters that included diagnoses of "syncope and collapse" (ICD-9-CM code: 780.2) in any diagnostic position.

For summary purposes, a "case" of syncope was defined as a service member with at least one medical encounter for "syncope and collapse" any time during the surveillance period; as such, each individual could be a case only once during the period. A "syncopal event" was defined as a service member with at least one syncope-related encounter in a day; as such, service members could be affected by multiple syncope events during the surveillance period. Frequencies, rates, and trends of syncope cases and syncopal events were calculated separately. For incidence rate estimates, population-time at risk was all active duty time of individuals serving in the active component of the U.S. Armed Forces during the surveillance period.

For estimation purposes, an immunization episode was defined as one or more immunizations administered to an individual in a given day. A case of "postvaccination syncope" was defined as a syncope-related medical encounter that occurred on the same day as an immunization episode. Affected service members could be considered cases of postvaccination syncope only once per day regardless of the number of immunizations received during the immunization episode.

Rates of postvaccination syncope were calculated by dividing the number of postvaccination syncope cases by the number of "immunization episodes" in a population and during a time period of interest.

Because immunizations given by injection are those most consistently associated with syncope risk, vaccines administered orally (e.g., adenovirus vaccine) or nasally (e.g., FluMist® influenza vaccine) and tuberculin skin tests were not considered exposures of interest in the analysis.

Illnesses and injuries were considered "co-occurring" with syncope if they were diagnosed (and reported in the first or second diagnostic positions) during a medical encounter in which syncope was also diagnosed.

## RESULTS

During the 15-year surveillance period, 322,823 syncopal events were documented among 153,172 affected service members (mean: 2.1 syncopal events per

**TABLE 1.** Incident counts and incidence rates (per 1,000 person-years) of syncope cases[a] and syncopal events,[b] active component, U.S. Armed Forces, 1998-2012

| | Syncope cases[a] | | Syncopal events[b] | |
|---|---|---|---|---|
| | No. | Rate | No. | Rate |
| Total | 153,172 | 7.2 | 322,823 | 15.1 |
| Gender | | | | |
| Male | 106,437 | 5.8 | 221,106 | 12.1 |
| Female | 46,735 | 15.1 | 101,717 | 32.9 |
| Age | | | | |
| <20 | 28,256 | 18.0 | 48,985 | 31.2 |
| 20-24 | 57,605 | 8.3 | 119,589 | 17.1 |
| 25-29 | 26,991 | 5.8 | 60,139 | 12.9 |
| 30-34 | 15,122 | 4.8 | 34,873 | 11.0 |
| 35-39 | 12,662 | 4.6 | 29,238 | 10.6 |
| 40+ | 12,536 | 5.6 | 29,999 | 13.5 |
| Race/ethnicity | | | | |
| White, non-Hispanic | 96,850 | 7.2 | 205,996 | 15.3 |
| Black, non-Hispanic | 29,746 | 8.0 | 63,481 | 17.1 |
| Hispanic | 13,143 | 6.2 | 26,375 | 12.4 |
| Asian/Pacific Islander | 4,280 | 5.2 | 8,375 | 10.2 |
| Other/unknown | 9,153 | 7.3 | 18,596 | 14.7 |
| Service | | | | |
| Army | 62,200 | 8.2 | 133,087 | 17.5 |
| Navy | 31,988 | 6.1 | 63,594 | 12.1 |
| Air Force | 38,176 | 7.3 | 83,509 | 16.1 |
| Marine Corps | 17,248 | 6.3 | 34,645 | 12.6 |
| Coast Guard | 3,560 | 6.1 | 7,988 | 13.8 |
| Grade | | | | |
| Enlisted | 138,304 | 7.7 | 290,614 | 16.3 |
| Officer | 14,868 | 4.3 | 32,209 | 9.2 |
| Status | | | | |
| Recruit | 13,113 | 30.5 | 19,672 | 45.8 |
| Active (non-recruit) | 140,059 | 6.7 | 303,151 | 14.5 |
| Military occupation | | | | |
| Combat-specific[c] | 15,064 | 5.7 | 31,814 | 12.0 |
| Armor/motor transport | 7,515 | 8.0 | 15,225 | 16.2 |
| Pilot/aircrew | 2,839 | 3.6 | 5,575 | 7.0 |
| Repair/engineer | 36,603 | 5.8 | 79,750 | 12.7 |
| Communication/intelligence | 34,991 | 7.2 | 76,207 | 15.7 |
| Health care | 14,588 | 8.3 | 31,381 | 17.9 |
| Other | 41,572 | 10.1 | 82,871 | 20.1 |

[a]A syncope case=one syncope medical encounter per person per surveillance period.
[b]A syncopal event=one syncope medical encounter per person per day.
[c]Infantry, artillery, combat engineering

affected individual) **(Table 1)**. The incidence rate of syncope in active component service members was 7.2 per 1,000 person-years (p-yrs); the rate of syncopal events was 15.1 per 1,000 p-yrs.

Of all affected individuals, approximately two-thirds (n=99,046; 64.6%) had one, 15.9 percent (n=24,322) had two, 6.8 percent (n=10,436) had three, 3.8 percent (n=5,790) had four, and 2.5 percent (n=3,773) had five syncopal events during the surveillance period **(data not shown)**. The remaining 6.5 percent (n=10,025) of affected service members had from 6 to 88 reported syncopal events during the period.

The crude annual incidence rate of syncope cases increased by 88.6 percent from 1998 (rate: 4.6 per 1,000 p-yrs) to 2012 (8.6 per 1,000 p-yrs) **(Figure 1)**. Overall and in every year during the period, incidence rates of syncope cases were highest among service members under 20 years of age. The incidence rate in service members under 20 years of age increased 115 percent from 1998 to 2007 (23.2 per 1,000 p-yrs), was stable from 2007 to 2009, and then decreased 21 percent through 2012 (18.3 per 1,000 p-yrs). Incidence rates in the other age groups increased linearly, but by much less overall, from 1998 through 2012 **(Figure 1)**.

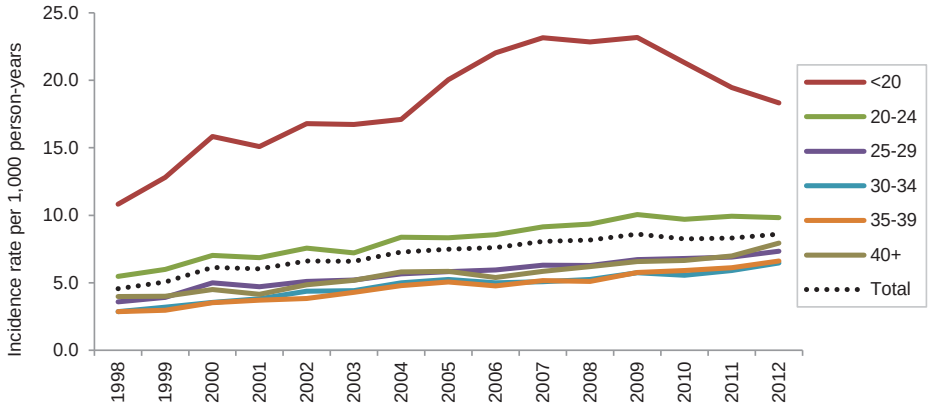
In general, incidence rates of both syncope cases and syncopal events were much higher among women than men, particularly among those younger than age 20. Among both males and females, incidence rates of syncope were highest by far in the youngest group (<20 years) and declined with increasing age through the mid-thirties **(Table 1, Figure 2)**.

Among racial/ethnic groups, rates of syncope and syncopal events were highest among service members who were black, non-Hispanic or "other/unknown" racial/ethnic identities and lowest among Asian/Pacific Islanders **(Table 1)**. Compared to their respective counterparts, service members who were in the Army, enlisted, recruits, and with "other" military occupations (e.g., no military occupational specialty skills, initial entry trainees) had higher rates and those in pilot/aircrew occupations had lower rates, of syncope and syncopal events.

## Co-occurring conditions

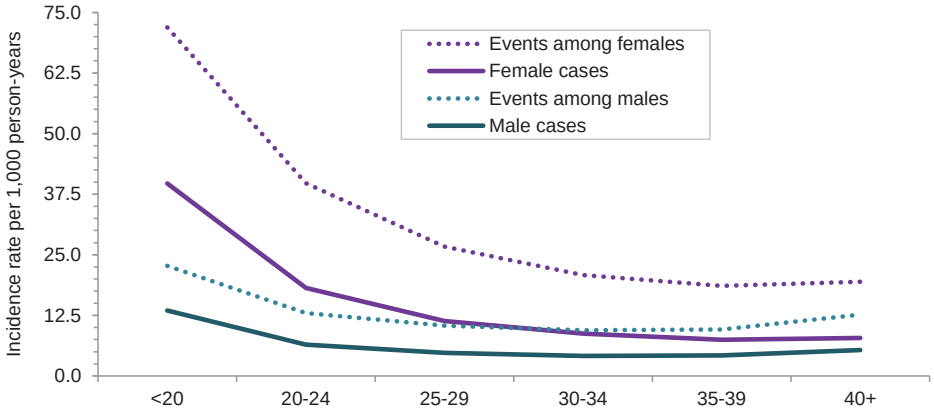
Injuries were diagnosed during 12,998 (4.0%) medical encounters at which "syncope and collapse" was also diagnosed **(data not shown)**. The injuries that were most frequently diagnosed during the same medical encounters as syncope were open wounds of the head (n=2,547); other/unspecified injuries (n=2,590); contusions of the

**FIGURE 1.** Incidence rates of syncope cases[a] overall and by age groups, active component, U.S. Armed Forces, 1998-2012




[a]One per person during the surveillance period.

**FIGURE 2.** Incidence rates of syncope cases[a] and syncopal events[b] by gender, active component, U.S. Armed Forces, 1998-2012




[a]One per person during the surveillance period.
[b]One event per person per day.

head (n=1,395); concussions (n=1,145); sprains and strains of the back (n=667); and fractures of the skull, face, clavicle, or vertebrae (n=584). Of note, more serious injuries within these categories include skull fractures (n=119), fractures of vertebral column (n=91), cerebral lacerations, contusions, or other intracranial injuries (n=335), and open wound of the eyeball or ocular adnexa (n=62).

Other relatively common diagnoses during syncope-related medical encounters were diseases and symptoms involving the cardiovascular system (e.g., dysrhythmias, palpitations, hypertension) (n=23,995); diseases and symptoms involving the respiratory system (e.g., respiratory infections, unspecified chest pain) (n=22,965); symptoms involving the head and neck (e.g., headache and migraines) (n=12,151); disorders of fluid, electrolyte, and acid-base balance (e.g., dehydration, volume depletion) (n=8,558); and diseases and symptoms of the digestive system (e.g., nausea/vomiting, viral enteritis) (n=7,420) **(data not shown)**.

## Postvaccination syncope

During the 15-year surveillance period, there were 51,101,639 immunization episodes and 4,954 medical encounters for "syncope and collapse" on the same days as immunization episodes. The crude overall rate of medical encounters for postvaccination syncope was 9.7 per 100,000 immunization episodes **(Table 2)**.

Annual rates of postvaccination syncope more than tripled from 1998 (4.4 per 100,000 immunization episodes) to 2006 (14.1 per 100,000 immunization episodes) and then were relatively stable from 2006 to 2012 (range: 11.0-13.6 per 100,000 immunization episodes) **(Figure 3)**. Overall, and in every year of the period, rates of postvaccination syncope were much higher among

**TABLE 2.** Counts[a] and rates (per 100,000 immunizations) of postvaccination syncope,[a] active and reserve components, U.S. Armed Forces, 1998-2012

| | No. | Rate |
|---|---|---|
| Total | 4,954 | 9.7 |
| Component | | |
| Active | 3,863 | 10.4 |
| Reserve\Guard | 1,091 | 7.8 |
| Gender | | |
| Male | 3,655 | 8.4 |
| Female | 1,299 | 17.5 |
| Age | | |
| <20 | 1,426 | 21.0 |
| 20-24 | 1,838 | 11.1 |
| 25-29 | 688 | 7.2 |
| 30-34 | 347 | 5.3 |
| 35-39 | 306 | 5.6 |
| 40+ | 349 | 5.7 |
| Race/ethnicity | | |
| White, non-Hispanic | 3,630 | 11.0 |
| Black, non-Hispanic | 616 | 7.7 |
| Hispanic | 331 | 6.3 |
| Asian/Pacific Islander | 89 | 4.7 |
| Other/unknown | 288 | 10.2 |
| Service | | |
| Army | 1,895 | 8.9 |
| Navy | 727 | 7.5 |
| Air Force | 1,689 | 13.4 |
| Marine Corps | 525 | 7.7 |
| Coast Guard | 118 | 15.7 |
| Grade | | |
| Enlisted | 4,438 | 10.0 |
| Officer | 516 | 7.5 |
| Military occupation | | |
| Combat-specific[b] | 381 | 5.8 |
| Armor/motor transport | 193 | 7.9 |
| Pilot/aircrew | 97 | 5.7 |
| Repair/engineer | 972 | 7.5 |
| Communication/ intelligence | 815 | 8.4 |
| Health care | 271 | 7.4 |
| Other | 2,225 | 15.8 |

[a]No more than one immunization episode per individual per day.
[b]Infantry, artillery, combat engineering

**FIGURE 3.** Rates (per 100,000 immunizations) of postvaccination syncope by age, active and reserve components, U.S. Armed Forces, 1998-2012

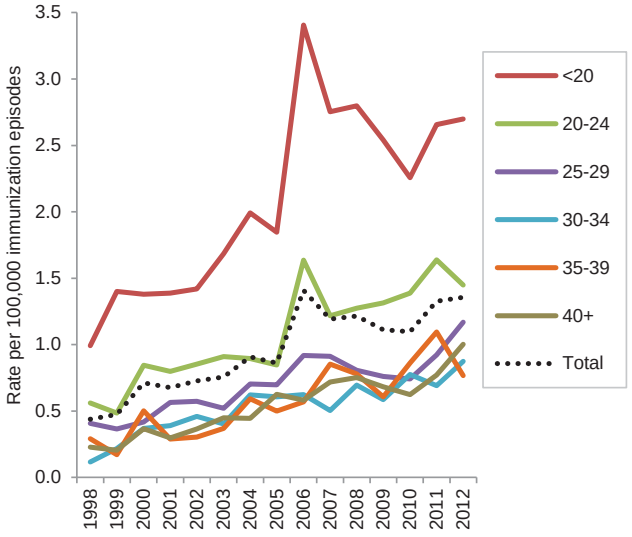
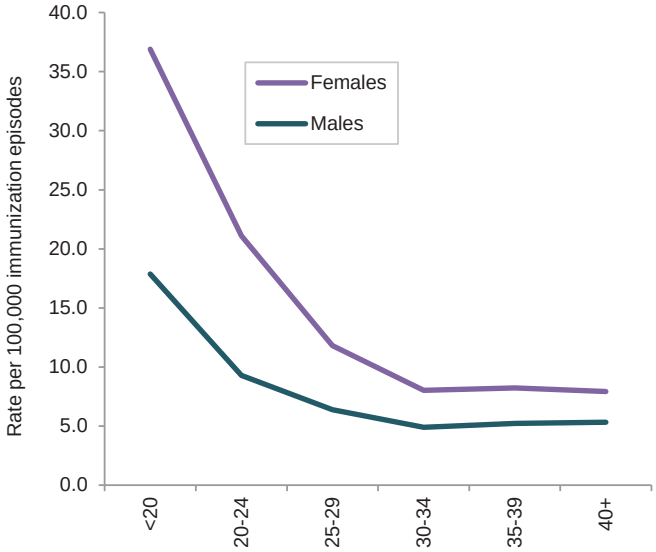



**FIGURE 4.** Rates (per 100,000 immunizations) of postvaccination syncope by gender, active and reserve components, U.S. Armed Forces, 1998-2012




service members younger versus older than 20 years.

The rate of postvaccination syncope was more than twice as high among females as males and sharply declined with increasing age **(Table 2, Figure 4)**. Crude rates were higher among members of the Coast Guard and Air Force, those in "other" occupations (which include those without an identified occupation, e.g., recruits), and among white, non-Hispanic and enlisted service members compared to their respective counterparts **(Table 2)**.

Approximately 9.7 percent of all postvaccination syncope cases (n=479) occurred during the first two weeks of service **(data not shown)**. The Marine Corps (16.8%), Coast Guard (13.6%), and Air Force (12.0%) had higher percentages of postvaccination syncope cases during the first two weeks of service than the Navy (6.6%) and Army (6.5%).

In general, the rate of syncope sharply increased as the number of injections per immunization episode increased. Compared to episodes with only one injection, rates of syncope were 100 percent, 286 percent, and 409 percent higher during episodes with two, three, and four or more injections, respectively **(Figure 5)**.

## Co-occurring conditions

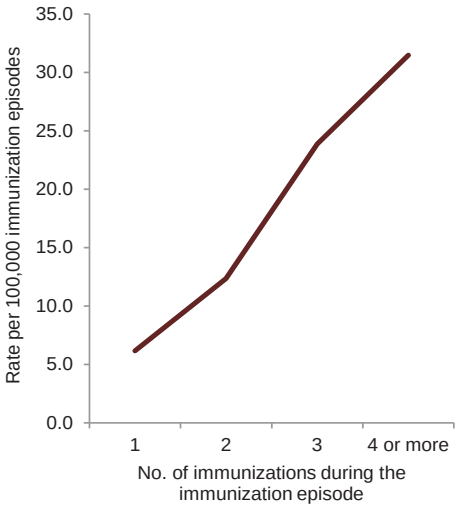
Injuries were diagnosed during 343 (6.9%) of the 4,954 medical encounters for postvaccination "syncope and collapse" **(data not shown)**. The most frequently co-occurring injuries with postvaccination syncope were open wounds of the head (n=111); contusions of the head (n=65); other/unspecified injuries (n=46); concussions (n=22); other/unspecified injuries of the head (n=15); and fractures of the skull, face, or clavicle (n=10). Of note, more serious injuries within these categories include other intracranial injuries (n=5), skull fractures (n=2), and open wound of the eyeball or ocular adnexa (n=2).

Other conditions that were relatively frequently diagnosed during the same medical encounters as postvaccination syncope were diseases and symptoms involving the cardiovascular system (e.g., dysrhythmias, hypertension) (n=202); disorders of fluid, electrolyte, and acid-base balance (e.g., dehydration, volume depletion) (n=177); diseases and symptoms involving the respiratory system (e.g., respiratory infections, unspecified chest pain) (n=264); and symptoms involving the head and neck (e.g., headache and migraines) (n=118) **(data not shown)**.

## EDITORIAL COMMENT

This report documents that, each year on average over the past 15 years, approximately 21,500 syncopal events (all types) have affected 10,200 active component service members.

**FIGURE 5.** Rates (per 100,000 immunization episodes) of postvaccination syncope by the number of immunizations given during an immunization episode, active and reserve component, U.S. Armed Forces, 1998-2012



Many syncopal events were associated with medical conditions that likely precipitated the syncopal episodes (e.g., cardiac arrhythmias, acute gastrointestinal/respiratory illnesses) or with injuries that likely were caused by syncope-related collapses. Of particular note, some injuries that were diagnosed at the same medical encounters as syncope were extremely serious and potentially life threatening (e.g., cerebral lacerations/contusions, spinal column fractures). The findings strongly suggest the need for better syncope-related injury prevention policies and practices. In this regard, the identification and protection from injury of individuals at particularly high risk of postvaccination syncope and collapse should be a high priority. Such individuals include military recruits (particularly females) and adults of all ages and genders with histories of immunization-related syncope.

In this report, after a first documented syncopal episode while in military service, approximately one-third of those affected had had at least one additional syncopal event during service. After a second or third syncopal episode while in military service, more than one half (55%) and two-thirds (65%), respectively, of those so affected had at least one additional syncopal event during service. Clearly, service members with any history of syncope are at sharply increased risk of additional episodes – and those with multiple prior episodes of syncope are at extremely increased risk of additional episodes and should be specifically protected from syncope-related injuries.

Syncope is a well-known consequence of vaccination. During the 15-year surveillance period, 4,954 syncope events occurred on the same days as immunizations. The rate of postvaccination syncope among active and reserve component service members was 9.7 per 100,000 immunizations. Similar to rates of syncope (all types) in the active component, postvaccination syncope was highest among females and younger aged service members. The Coast Guard and Air Force had the highest rates of postvaccination syncope (>13 per 100,000 immunizations) as well as the relatively highest proportions of postvaccination syncope during the first two weeks of service.

The rate of clinically significant syncope after receiving immunizations by injection is generally low; however, this report documents that the rate sharply increased when multiple injections were administered. Because so many service members receive immunizations by injection, and since multiple injections are often given concurrently, hundreds of service members are treated for postvaccination syncope each year. This report documented hundreds of traumatic injuries that were at least temporally related to syncope and collapse of service members after immunization; many such injuries were severe, and most, if not all, likely were preventable.

The Advisory Committee on Immunization Practices (ACIP) of the Centers for Disease Control and Prevention (CDC) recommends that vaccine providers "strongly consider observing patients for 15 minutes after they are vaccinated. If syncope develops, patients should be observed until symptoms resolve."[4] At the start of recruit training, newly inducted service members receive multiple immunizations by injection; and in preparation for overseas deployments, members of military units often receive immunizations in large groups. The risk of serious complications of postvaccination syncope may be increased when immunizations are given to military groups outside of medical facilities - rather than to individuals in clinic settings. For example, in clinics, vaccinees can be seated during and after injections and monitored for syncope for reasonable time periods; in addition, flooring can be padded, and furniture and equipment can be shielded or removed from immunization rooms and patient waiting areas. Such precautions may be difficult to implement in non-medical facilities where mass immunizations are given (e.g., theaters, gymnasiums). Nonetheless, every measure to ensure the safety of immunization recipients should be taken, regardless of the location, setting, or circumstances of administration.

The results presented in this report should be interpreted in light of several limitations. The numbers reported here likely underestimate the actual numbers of syncope cases (individuals) and events (both overall and for postvaccination syncope). Uncomplicated syncopal episodes may be managed at sites where they occur (for example, at a medical aid station or a troop clinic) but may not be documented in medical records. Furthermore, some individuals may never seek care for syncopal episodes occurring at home and/or while off-duty.

Conversely, in the analysis that examined the total numbers of syncopal events and the numbers of such events per person, it is possible that the numbers of such events were overestimated. The diagnostic evaluations of some persons who experienced syncope may have required a series of subsequent outpatient encounters for consultations, special testing (e.g., Holter monitoring, other cardiovascular assessments), and follow-up visits. The medical record documentation of such encounters may have included repeat recordings of the diagnostic code for the original syncopal events that precipitated the follow-on evaluations. This analysis did not attempt to clarify the impact of follow-up care for syncope on the numbers of encounters for service members whose records suggested multiple events.

Additionally, the definition of postvaccination syncope used in this report is based on a temporal association (same day occurrence). True cause and effect (i.e., the vaccination caused the syncope event) could not be confirmed; therefore, some postvaccination syncope events may be classified as such incorrectly. Similarly, a cause and effect relationship between syncope and co-occurring conditions – particularly injuries – documented during the same encounter cannot be established with certainty.

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# Update: Motor Vehicle-related Deaths, Active and Reserve Components, U.S. Armed Forces, 1999-2012

From 1999 to 2012, there were 4,479 motor vehicle accident (MVA)-related deaths among members of the U.S. Armed Forces. Of these, the single most common underlying cause of death was motorcycle accidents (n=1,134; 25.6%). Among active component service members during the 14-year surveillance period, the annual number (n=355) and rate (25.1 per 100,000 person-years[p-yrs]) of MVA-related deaths peaked in 2004. Since then, a steady downward trend followed and the 2012 number (n=184) and rate (13.2 per 100,000 p-yrs) were the lowest of the entire period. For members of the reserve component, the annual number of deaths peaked in 2005 (n=86), but the number in 2012 (n=22) was the lowest of the period. In 2012, the number (n=90) and rate of deaths (6.5 per 100,000 p-yrs) related to motorcycle accidents among active component service members almost equaled the number (n=94) and rate of deaths (6.7 per 100,000 p-yrs) from all other types of motor vehicle accidents combined. During the entire period, numbers of fatal motor vehicle accidents tended to be higher in the warmer months of the year. After 2009, motor vehicle accidents were no longer the leading, non-war-related cause of death among U.S. service members.

Motor vehicle accidents (MVAs) have accounted for nearly one third of U.S. military deaths annually, and through 2009 were the leading non-war-related cause of death among U.S. military personnel.[1,2] Deaths due to MVAs among service members have been declining in recent years, to such an extent that in 2010 and 2011 there were more deaths from suicide and from war than from transportation accidents.

Studies focused on service members have identified several factors associated with increased risk of death due to motor vehicle crashes: relative youth, single marital status, male gender, and highest educational level of high-school completion.[3,4] Compared to their older counterparts, younger service members more commonly take risks while driving (e.g., speeding, inconsistent use of seat belts, driving while intoxicated) or ride motorcycles.

All services within the U.S. Armed Forces conduct safe driving campaigns and make such information available to their respective service members using a variety of media. The Army for example, requires all soldiers to undergo the Army Traffic Safety Training Program, which includes mandatory motorcycle training under the Progressive Motorcycle Program for soldiers who own motorcycles. Apart from the usual messaging on the avoidance of, or moderate consumption of alcohol before driving, wearing seat belts or helmets as appropriate, and defensive driving, these safety training programs extend to cover such topics as the proper installation and use of child safety seats, and maintaining safe personal motor vehicles in order to safeguard the lives of family members and other passengers.

This report updates previous summaries of numbers, rates, trends, and correlates of risk of motor vehicle accident related fatalities among service members since 1999. This report also describes military and demographic characteristics of service members who died in motorcycle and other motor vehicle accidents.

## METHODS

The surveillance period was 1 January 1999 to 31 December 2012. The surveillance population included all individuals who served on active duty as members of the active or reserve components of the U.S. Armed Forces at any time during the surveillance period.

Motor vehicle-related deaths of service members were ascertained from records maintained in the DoD Medical Registry of the Armed Forces Medical Examiner System and routinely provided to the Armed Forces Health Surveillance Center for integration into the Defense Medical Surveillance System (DMSS). For this analysis, a motor vehicle-related death was defined by a casualty record with an "underlying cause of death" code corresponding to a collision or non-collision motor vehicle accident. Motor vehicle deaths that were considered "intentional" (i.e., suicide or homicide) or war-related were excluded.

In this analysis, the summaries comprise numbers of deaths in the surveillance population overall (i.e., active and reserve component members on active duty) and mortality rates for members of the active component using person-years at risk rather than individuals at risk. Mortality rates were calculated as deaths per 100,000 person-years of active military service during the surveillance period. The U.S. military is a dynamic cohort – each day many individuals enter and many others leave service. Thus, in a given year there are many more individuals with any service than there are total person-years of active service. Reserve component members were not included in rate calculations because the start and end dates of their active duty service periods were not available.

## RESULTS

There were 4,479 motor vehicle-related deaths among service members during the

14-year surveillance period from 1999 through 2012 **(Table 1)**. These included 3,784 deaths in the active component (rate: 19.5 per 100,000 person-years [p-yrs]) and 695 deaths in the reserve component **(Table 2)**. Among the 10 categories of underlying motor vehicle accident-associated cause of death used in this analysis, the largest number of service member deaths (n=1,158; 25.9% of the total) was associated with motorcycle accidents (motorcyclist involved in any accident except collision with railway train).

The second highest number of deaths in a single category of vehicle deaths was for "other and unspecified" motor vehicle accidents which accounted for 783 or 17.5 percent of all MVA deaths. Throughout the surveillance period, there were 262 (5.8%) pedestrian-involved fatalities in collisions with motor vehicles. The five categories that specified that the decedent was the occupant of a vehicle accounted for 2,243 deaths (50.1% of all MVA deaths) **(Table 1)**. Overall, there were 3,321 non-motorcycle related deaths during the period.

Annual numbers of deaths from MVA among active component service members during the surveillance period peaked in 2004 (n=355; rate: 25.1 per 100,000 p-yrs) **(Figure 1)**. In general, annual counts and rates of motor-vehicle related deaths among active component service members have been declining since 2007. The year 2012 had the lowest annual number (n=184) and rate (13.2 per 100,000 p-yrs) of MVA deaths among active component service members during the entire surveillance period **(Figure 1)**.

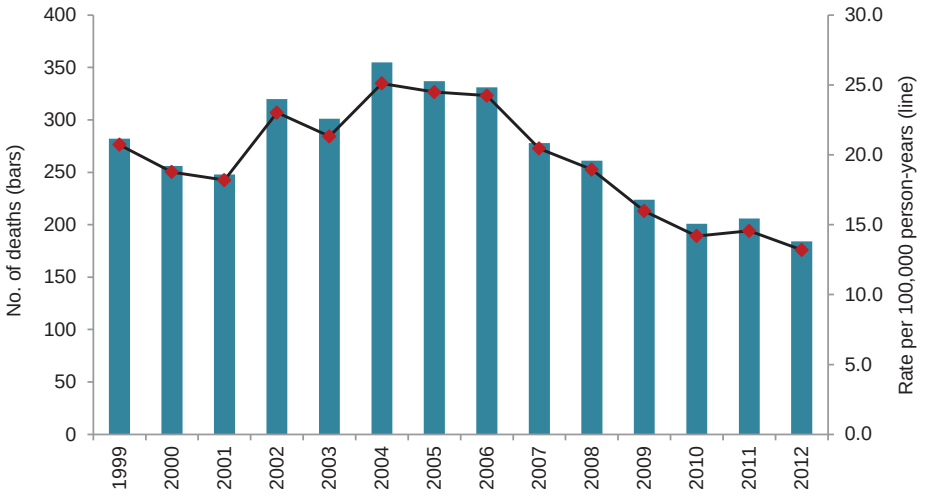
Annual MVA deaths among reserve component service members were highest from 2003 to 2005 (81, 81, and 86 deaths, respectively), but have been consistently lower since 2008. Most notably, reserve component MVA deaths in 2012 (n=22) were by far the fewest of any year in the surveillance period **(Figure 2)**.

Among active component service members in all of the services, the Army had the highest number of motor vehicle-related deaths overall (n=1,568; rate: 22.0 per 100,000 p-yrs; 41.4% of all MVA deaths) **(Table 2)** and in each year during the 14-year period **(Figure 3)**. However, the Marines had the highest overall rate, 29.8 per 100,000 p-yrs **(Table 2)**.

**TABLE 1.** Motor vehicle-related deaths by underlying cause of death category, active and reserve components, U.S. Armed Forces, January 1999-December 2012

| Underlying cause of death (UCOD) | Service member deaths | |
|---|---|---|
| | No. | % of total |
| Motorcyclist involved in any accident except collision with railway train | 1,158 | 25.9 |
| Other and unspecified motor vehicle accidents | 783 | 17.5 |
| Occupant of car, pickup, truck, or van involved in collision with other motor vehicle | 663 | 14.8 |
| Occupant of motor vehicle involved in collision with non-motorized road vehicle streetcar, animal, pedestrian, or fixed object | 607 | 13.6 |
| Occupant of motor vehicle involved in noncollision accident | 521 | 11.6 |
| Occupant of special-use motor vehicle involved in any accident (including military vehicle) | 447 | 10.0 |
| Pedestrian involved in collision with motor vehicle | 262 | 5.8 |
| Pedal cyclist involved in collision with motor vehicle | 22 | 0.5 |
| Other motor vehicle accident involving collision with railway train | 11 | 0.2 |
| Occupant of heavy transport vehicle or bus involved in collision with other motor vehicle | 5 | 0.1 |
| Total | 4,479 | 100.0 |

**FIGURE 1.** Annual numbers and rates of motor vehicle-related deaths, active component, U.S. Armed Forces, January 1999-December 2012




Male service members died as a result of MVAs at a higher rate overall when compared to their female counterparts (male rate: 21.4 per 100,000 p-yrs vs. female rate: 8.4 per 100,000 p-yrs). Although there were more deaths (counts) among white, non-Hispanic service members and those aged 20-24 compared to their respective counterparts, the rates of MVA deaths were highest among black, non-Hispanic service members (rate: 22.2 per 100,000 p-yrs) and those under the age of 20 (rate: 29.5 per 100,000 p-yrs) **(Table 2)**.

In 2012, each of the services (except Navy) had its lowest annual number of

**FIGURE 2.** Annual numbers of motor vehicle-related deaths, reserve component, U.S. Armed Forces, January 1999-December 2012

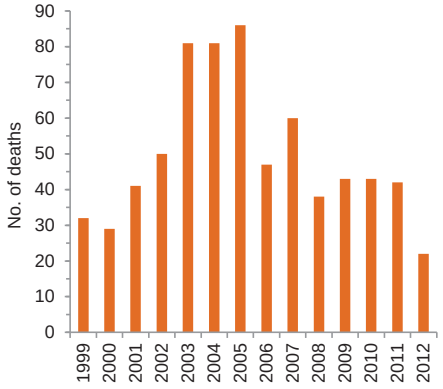


**TABLE 2.** Demographic and military characteristics of motor vehicle-related deaths (all types), active and reserve components, U.S. Armed Forces, January 1999 - December 2012

| | Active and reserve components | Active component | |
|---|---|---|---|
| | No. | No. of deaths | Rate[a] |
| Total | 4,479 | 3,784 | 19.5 |
| Service | | | |
| Army | 2,067 | 1,568 | 22.0 |
| Navy | 847 | 798 | 16.4 |
| Air Force | 740 | 651 | 13.5 |
| Marine Corps | 825 | 767 | 29.8 |
| Sex | | | |
| Male | 4,173 | 3,547 | 21.4 |
| Female | 306 | 237 | 8.4 |
| Race/ethnicity | | | |
| White, non-Hispanic | 2,772 | 2,329 | 19.2 |
| Black, non-Hispanic | 863 | 761 | 22.2 |
| Other | 844 | 694 | 18.0 |
| Age | | | |
| <20 | 489 | 424 | 29.5 |
| 20-24 | 2,058 | 1,835 | 28.7 |
| 25-29 | 874 | 755 | 17.8 |
| 30-39 | 765 | 609 | 11.4 |
| 40+ | 293 | 161 | 8.0 |
| Military occupation | | | |
| Combat-specific | 1,170 | 1,032 | 25.4 |
| Health care | 210 | 184 | 11.4 |
| Admin/supply | 985 | 791 | 17.2 |
| Other | 2,114 | 1,777 | 19.4 |

[a]Rate per 100,000 person-years

MVA-related deaths (active and reserve components combined) of the entire surveillance period. Among active component service members, 2012 had the lowest annual rates of MVA-related deaths among the Army and Marine Corps **(Figure 3)**.

Dramatic declines in the numbers and rates of non-motorcycle-related MVA deaths were responsible for the fall in rates for all MVA-related deaths **(Figure 4)**. For the entire 14-year surveillance period, slightly over 25 percent of all motor vehicle-related deaths were due to motorcycle accidents among active and reserve component service members combined. However, as a result of the decline in non-motorcycle-related MVA deaths since 2005, motorcycle-related deaths have become an increasingly higher proportion of all MVA-related deaths in the latter part of the surveillance period **(Figure 4)**.

In 2012, among active component service members, the rate of motorcycle deaths (6.5 per 100,000 p-yrs) was almost that of non-motorcycle MVAs (6.7 per 100,000 p-yrs) **(Figure 4)**. The largest numbers of motorcycle-related deaths affected active component service members (n=1,023), soldiers (n=457 overall; n=373 and rate: 5.2 per 100,000 p-yrs among active component

**FIGURE 3.** Annual numbers of motor vehicle-related deaths, by service, active and reserve components, U.S. Armed Forces, January 1999-December 2012

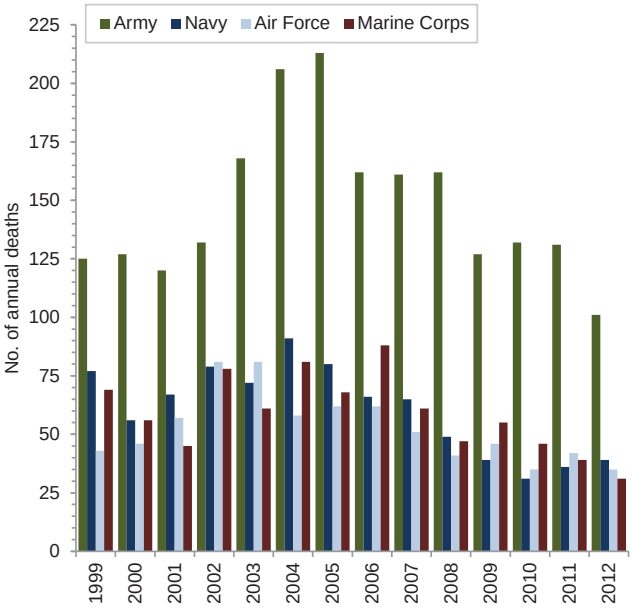
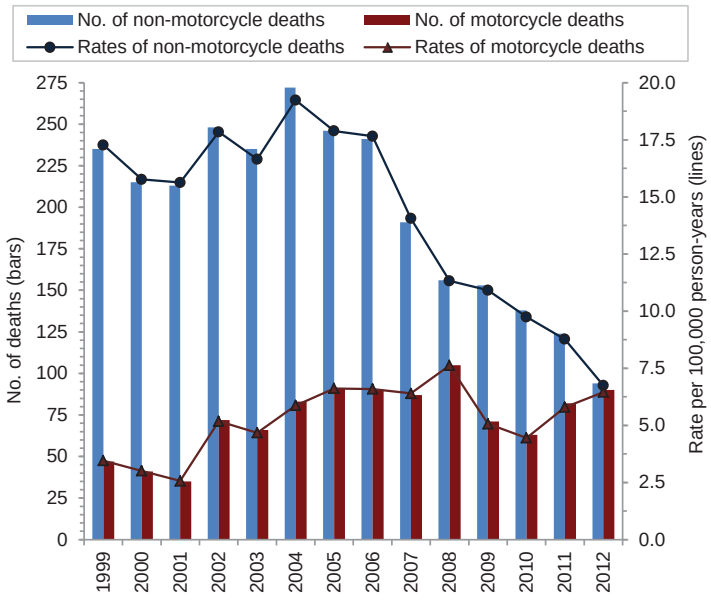



**FIGURE 4.** Motor vehicle-related deaths by year and underlying cause (motorcycle vs. all other), active component, U.S. Armed Forces, January 1999-December 2012



only), those aged 20-24 years, males, and white, non-Hispanics. The highest rates (active component only) were among Marines (rate: 6.9 per 100,000 p-yrs), those aged 20-24 years (rate: 6.4 per 100,000 p-yrs), and black, non-Hispanics (rate: 6.8 per 100,000 p-yrs) **(Table 3)**.

For the entire surveillance period, motorcycle-related death counts were lowest in January and higher during the months of April to September (warmer months) **(Figure 5)**. The average number of motorcycle-related deaths per month over the surveillance period was highest in July (n=150 overall). July also had the highest average number of deaths per day overall during the 14-year surveillance period. For non-motorcycle MVA-related deaths, there was a similar, though less-striking, seasonal pattern of numbers of fatalities.

When compared to all causes of death among service members for the last five years (2008 through 2012), MVA-related deaths have accounted for a decreasing proportion of all deaths in the active and reserve components of the U.S. Armed Forces **(Figure 6)**. In 2012, the percentage of all deaths among active and reserve component service members attributable to MVAs was the lowest (15.8%) in the 5-year period.

**TABLE 3.** Demographic and military characteristics of motorcycle-related deaths, active and reserve components, U.S. Armed Forces, January 1999-December 2012

| | Active and reserve components | Active component | |
|---|---|---|---|
| | No. | No. of deaths | Rate[a] |
| Total | 1,158 | 1,023 | 5.3 |
| Service | | | |
| Army | 457 | 373 | 5.2 |
| Navy | 272 | 260 | 5.3 |
| Air Force | 235 | 211 | 4.4 |
| Marine Corps | 194 | 179 | 6.9 |
| Sex | | | |
| Male | 1,128 | 998 | 6.0 |
| Female | 30 | 25 | 0.9 |
| Race/ethnicity | | | |
| White, non-Hispanic | 718 | 636 | 5.2 |
| Black, non-Hispanic | 255 | 232 | 6.8 |
| Other | 185 | 155 | 4.0 |
| Age | | | |
| <20 | 42 | 40 | 2.8 |
| 20-24 | 442 | 412 | 6.4 |
| 25-29 | 292 | 262 | 6.2 |
| 30-39 | 280 | 245 | 4.6 |
| 40+ | 102 | 64 | 3.2 |
| Military occupation | | | |
| Combat-specific | 270 | 252 | 6.2 |
| Health care | 49 | 42 | 2.6 |
| Admin/supply | 233 | 185 | 4.0 |
| Other | 606 | 544 | 5.9 |

[a]Rate per 100,000 person-years

**FIGURE 5.** Motor vehicle-related deaths by month (motorcycle vs. all other), active and reserve components, U.S. Armed Forces, 1999-2012

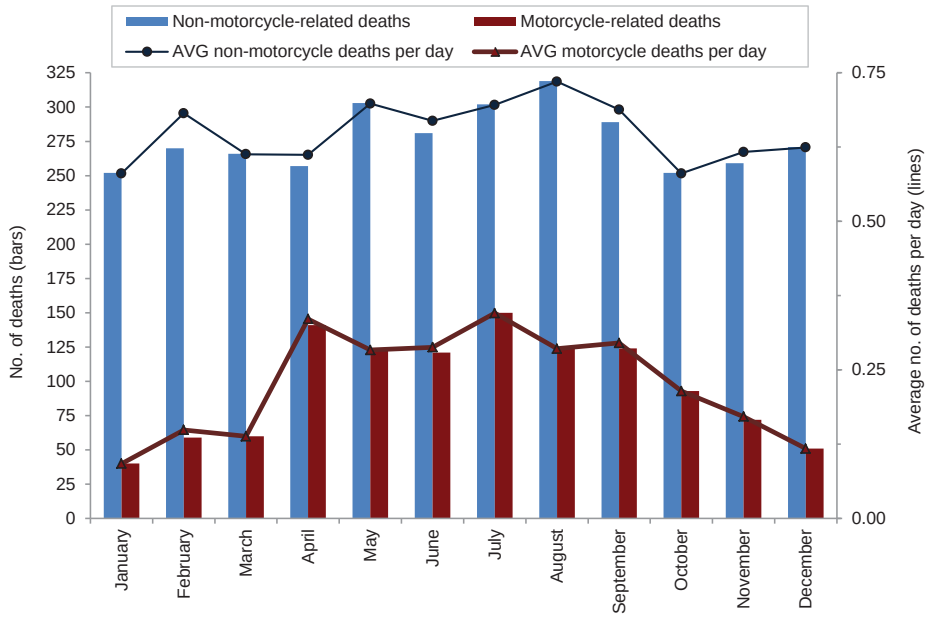
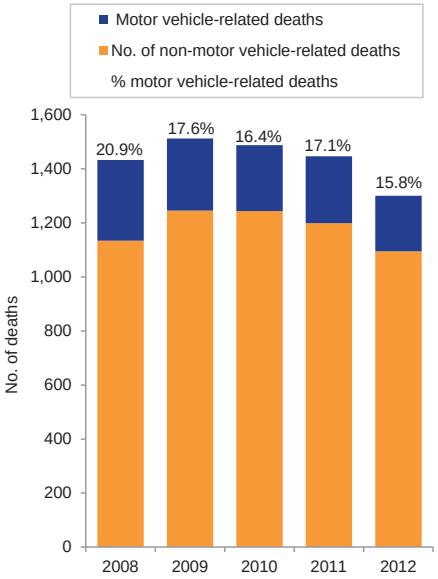



**FIGURE 6.** Comparison of number of deaths from all non-motor vehicle-related causes to motor vehicle-related deaths, active and reserve components, U.S. Armed Forces, 2008-2012



## EDITORIAL COMMENT

Bell, et al.[4] reported in a 2000 analysis of self-reported risk taking behaviors among soldiers hospitalized for injuries as a result of motor vehicle accidents that heavy drinking, drinking and driving, speeding, low seat belt use, younger age, minority race/ethnicity, and enlisted rank were significantly associated with motor vehicle injury. They concluded that many of the self-identified risk factors associated with motor vehicle injuries were indeed modifiable (e.g., drinking, speeding, and infrequent seat belt use). Moreover, the authors' recommendation was that programs that meet the needs of young and minority soldiers, and that target high risk behaviors are needed. Twelve years later, the data in this report show some encouraging improvements within the U.S. military population.

During the 14-year surveillance period, annual counts and rates of MVA deaths among active component service members peaked in 2004, and began a sustained decline through 2012. By 2012, annual deaths due to MVAs had declined by 34.8 percent since 1999 and by 48.2 percent since the peak in 2004. In 2012 counts and rates of MVA deaths in the active component of all services reached their lowest levels of the entire surveillance period. Similarly, MVA deaths among reservists in 2012 were dramatically lower than any other year of the surveillance period.

Although the findings of this update are encouraging with respect to motor vehicle accidents overall, it is concerning that rates of motorcycle-related fatalities among service members have risen in the two years since 2010. Moreover, the counts and rates of motorcycle-related deaths among U.S. military service members have remained higher in recent years than they were at the beginning of the surveillance period. In 2012, the counts and rates of deaths from motorcycle accidents among active component service members were nearly equal to those from non-motorcycle accidents.

Since 2009, the Department of Defense has required service members who intend to own a motorcycle to enroll and participate in motorcycle safety courses. Such training is expected to be conducted within 30 duty days of request for training for initial riders, and at least every five years as a refresher.[5] The underlying or main challenges in reducing motorcycle-related fatalities among service members remain unclear. By all appearances, the requisite policies and programs are in place, and have been made applicable to all service members meeting the criteria (i.e., those who own or intend to own a motorcycle). Furthermore, the safety training programs incorporate motorcycle maintenance tips and advice on protective clothing, and some even go so far as to provide first hand testimonials from service members who have been involved in accidents, but somehow survived. Perhaps greater efforts need to be made to encourage those most at risk – young service members – to appreciate their own vulnerability with respect to motorcycle crashes and to modify their riding behaviors accordingly.

Several differences in temporal and epidemiologic characteristics of fatal MVAs are described in this report. Fatalities due to motorcycle accidents occurred more frequently during warmer months, in contrast to the less dramatic seasonal pattern of incident non-motorcycle-related fatalities. Male service members in the active component died from motor vehicle accidents at a rate more than twice that of their female counterparts. Compared to their older counterparts, younger members of the Armed Forces are at a higher risk of fatalities due to motor vehicle accidents. The same is true for black, non-Hispanic service members in comparison to their counterparts.

There are several limitations to this analysis that should be considered when interpreting the results. First, the outcomes measured were deaths from MVAs. The analysis did not compile the numbers or rates of all MVAs (fatal and non-fatal), so it was not possible to assess whether or not a decrease in rates of MVAs was responsible for the decline in MVA death rates. Accordingly, it is unclear if the previously described safety training initiatives have had the desired effect on the incidence of MVA accidents overall, a major determinant of MVA fatalities. It is possible that modern automotive engineering advances designed to make MVAs more survivable have yielded lower fatality rates even if the numbers of accidents have not declined appreciably.

Second, although the documented recent trends in fatal MVAs attributable to motorcycle accidents do not show major improvements in the associated rates – in contrast to the sharp declines in deaths from non-motorcycle MVAs – this analysis does not clarify the risks attendant to motorcycle-related deaths. Rates in this report were calculated using a population-based denominator, i.e., person-years of all active component service members. A better denominator for assessment of trends in motorcycle fatalities would be person-years of service of motorcycle operators. It is possible that the numbers of motorcycle owners or operators have increased significantly during the surveillance period, so a more accurate, rate-based estimate of the risk of fatal motorcycle accidents over time would be possible with such exposure data (currently not available).

Third, the analysis does not account for the deaths of service members who were on active duty at the time of ultimately fatal MVAs but who died of the resulting injuries after they left active duty (e.g., following medical disability retirement). Also the analysis did not account for fatal MVAs among reserve component members who were not on active duty at the times of their accidents. Because such deaths were not included, the mortality impact of motor vehicle accidents on the total U.S. Armed Forces is likely underestimated in this report.

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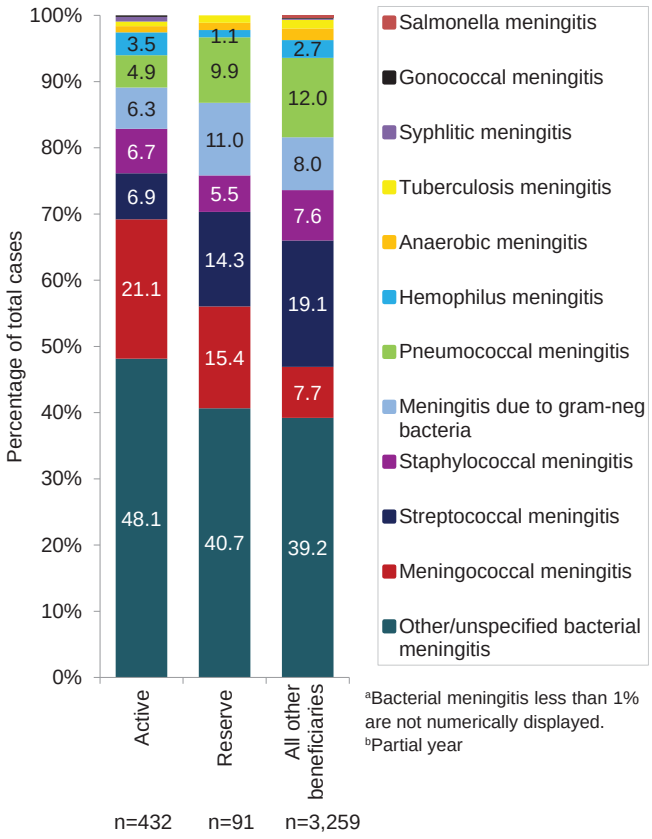
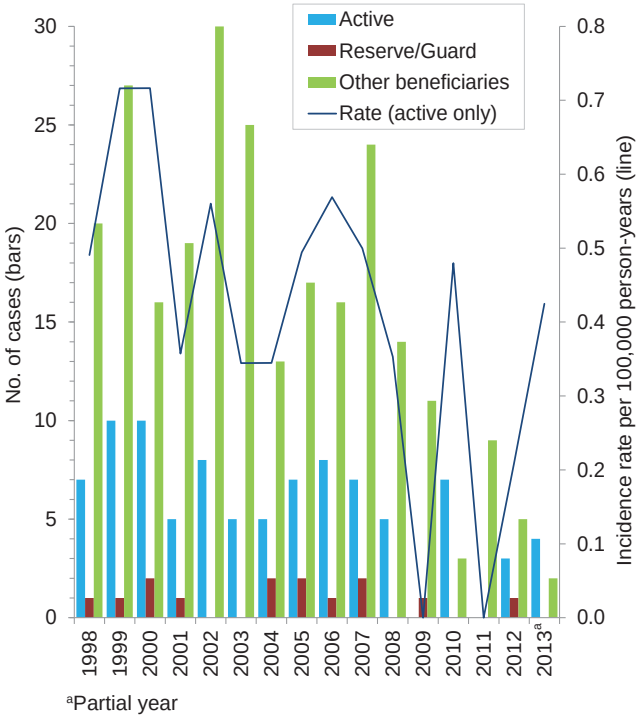
# Surveillance Snapshot: Bacterial Meningitis Among Beneficiaries of the Military Health System, 1998-2013

**FIGURE 1.** Percentage distribution, by bacterial etiology,[a] of cases of bacterial meningitis among Military Health System beneficiaries, 1998-2013[b]




[a]Bacterial meningitis less than 1% are not numerically displayed.
[b]Partial year

**FIGURE 2.** Incident counts and incidence rates of meningococcal meningitis cases by beneficiary type, beneficiaries of the Military Health System, 1998-2013[a]




[a]Partial year

From 1998 to 2013 (partial year), 3,782 beneficiaries of the Military Health System (MHS) were diagnosed as cases of bacterial meningitis. Cases were ascertained from diagnoses recorded in special electronic reports of meningococcal meningitis (a Reportable Medical Event in the MHS) or in records of inpatient hospital stays in which bacterial meningitis was documented in the primary or secondary diagnostic position. Among the three types of beneficiary groups, the proportions of meningitis cases by bacterial type varied **(Figure 1)**. In active and Reserve/Guard component service members, meningococcal meningitis was the most commonly documented specified type of bacterial meningitis. Among all other beneficiaries (e.g., spouses, children, retirees, etc.) streptococcal meningitis was the most commonly specified type of bacterial meningitis.

Meningococcal meningitis was diagnosed among 91 active component service members, 14 Reserve/Guard service members, and 251 other beneficiaries **(Figure 2)**. The overall rate in active component service members was 0.41 per 100,000 person-years. The incidence rate was relatively stable from 1998 to 2008, and then varied greatly from 2009 through 2013. In 2009 and 2011, there were no cases of meningococcal meningitis in active component service members. During the entire surveillance period, there were documented an additional 266 cases of meningococcal disease that were not recorded as meningitis. These included meningococcemia (n=150), carditis (n=13), and other specified and unspecified meningococcal infections (n=103). These cases affected 38 active component members, 6 Reserve and Guard members, and 222 other beneficiaries.

# Surveillance Snapshot: Age and Gender Distribution of Service Members, Active Component, U.S. Armed Forces, Compared to the U.S. Population, 2011

**FIGURE 1.** Percentage distribution by age and gender, active component, U.S. Armed Forces, 2011

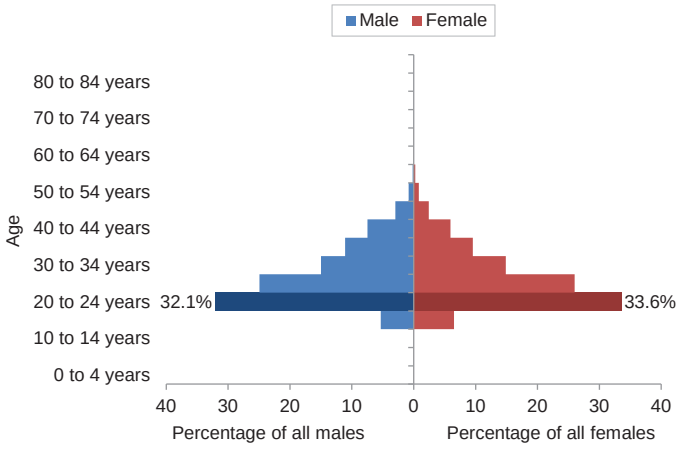
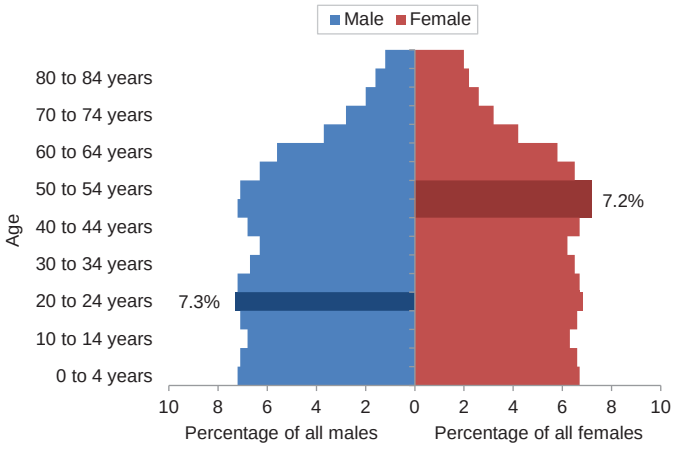



**FIGURE 2.** Percentage distribution by age and gender, U.S. general population, 2011



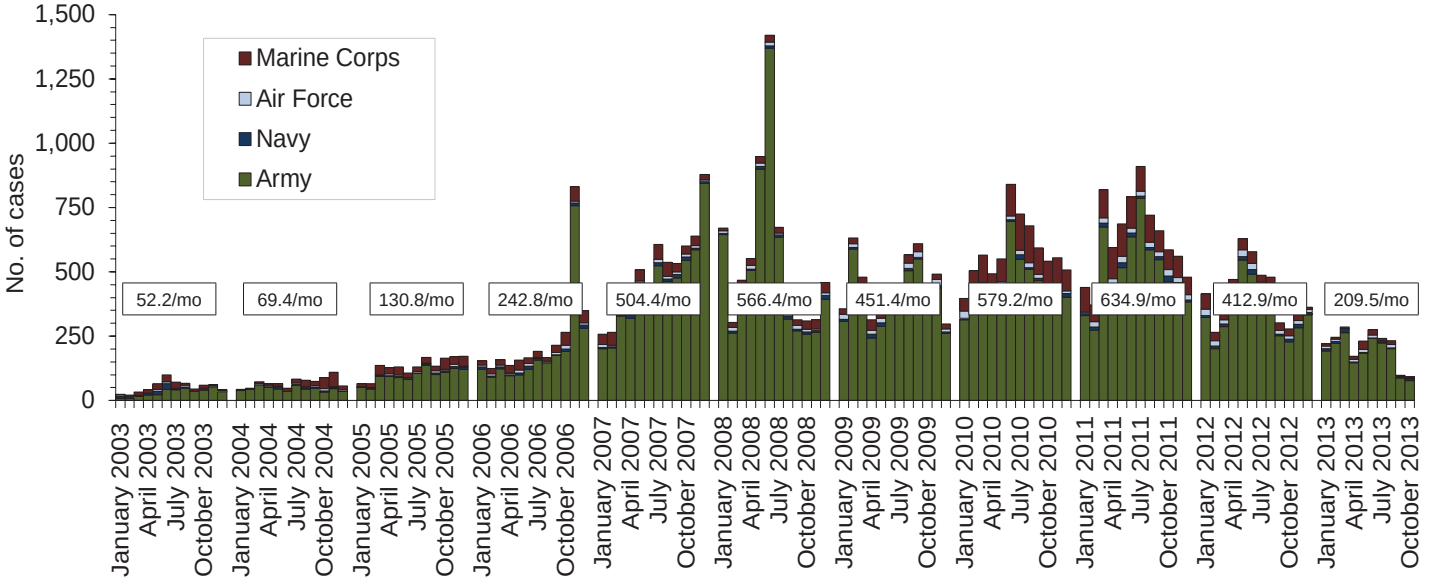

Figures 1 and 2 depict the 2011 population pyramids for the active component of the U.S. Armed Forces and for the U.S. civilian population. There were no service members under the age of 17 and 95.9 percent of male service members and 96.4 percent of female service members were under the age of 45. The median age of males was 27 years and that of females was 26 years. Males constitute 85.4 percent of active component service members and women 14.6 percent.

In contrast, 22.4 percent of the 2011 U.S. civilian population was under the age of 17 and the proportions of men and women who were in the age range 17 through 44 were 38.7 percent and 36.9 percent respectively. The median ages of civilian males and females were 35 and 38 years, respectively. The U.S. civilian population was 49.2 percent male and 50.8 percent female.

Although the Armed Forces Health Surveillance Center's Defense Medical Surveillance System contains records of all service members' demographic characteristics and of almost all their health care encounters (diagnoses and procedures) in the Military Health System, the results of epidemiologic analyses of this population are usually not generalizable to the U.S. population as a whole. Not only does the age and gender distribution of active component service members differ greatly from the general U.S. population, but applicants for military service must meet standards of health and fitness in order to qualify for entry. As a result, the vast majority – although not all – of the relatively young members of the Armed Forces begin their service free of detectable chronic disease and pre-morbid conditions.

# Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003-October 2013 (data as of 18 November 2013)

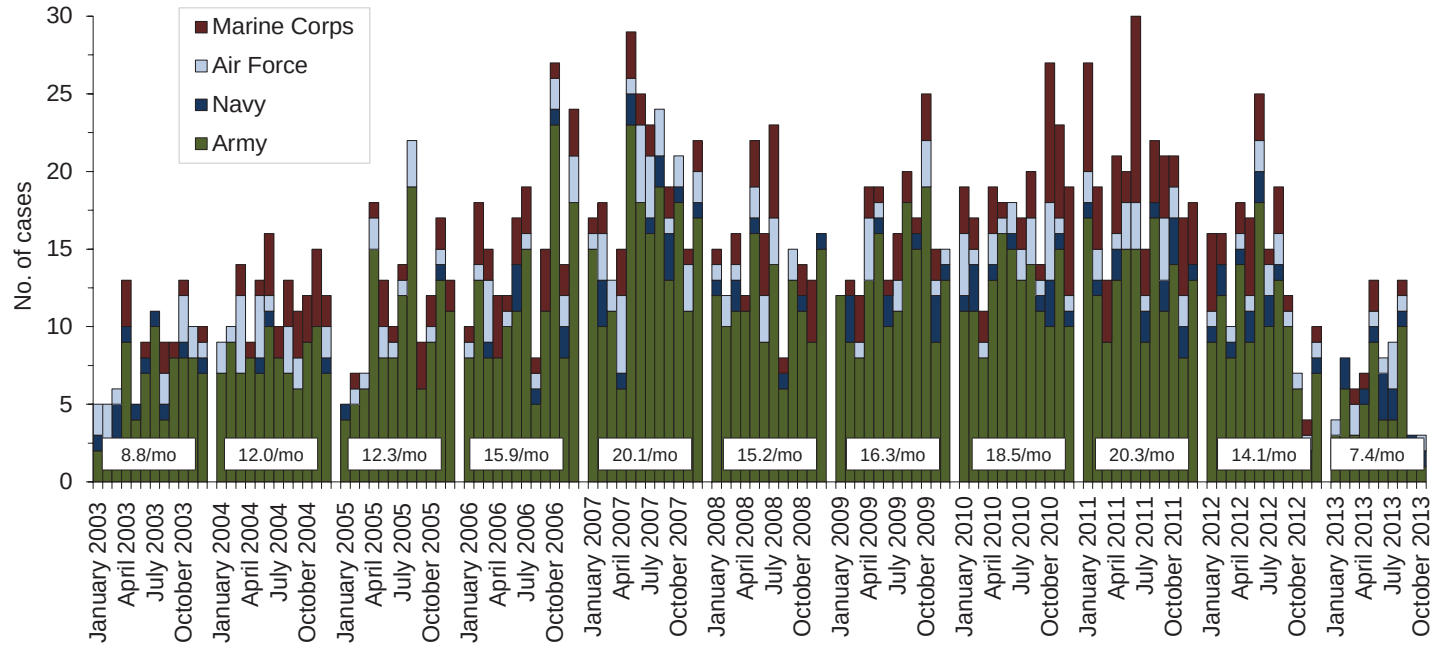
Traumatic brain injury (ICD-9: 310.2, 800-801, 803-804, 850-854, 907.0, 950.1-950.3, 959.01, V15.5_1-9, V15.5_A-F, V15.52_0-9, V15.52_A-F, V15.59_1-9, V15.59_A-F)[a]




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.

[a]Indicator diagnosis (one per individual) during a hospitalization or ambulatory visit while deployed to/within 30 days of returning from OEF/OIF. (Includes in-theater medical encounters from the Theater Medical Data Store [TMDS] and excludes 4,319 deployers who had at least one TBI-related medical encounter any time prior to OEF/OIF).

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

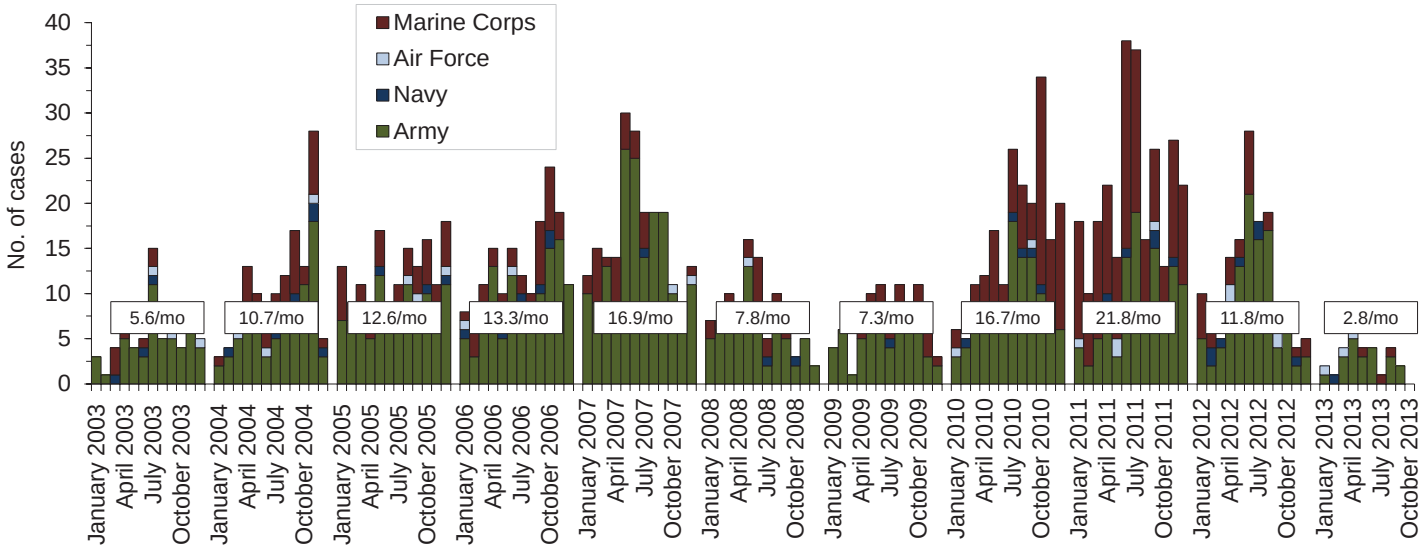



Reference: Isenbarger DW, Atwood JE, Scott PT, et al. Venous thromboembolism among United States soldiers deployed to Southwest Asia. *Thromb Res*. 2006;117(4):379-83.

[b]One 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.

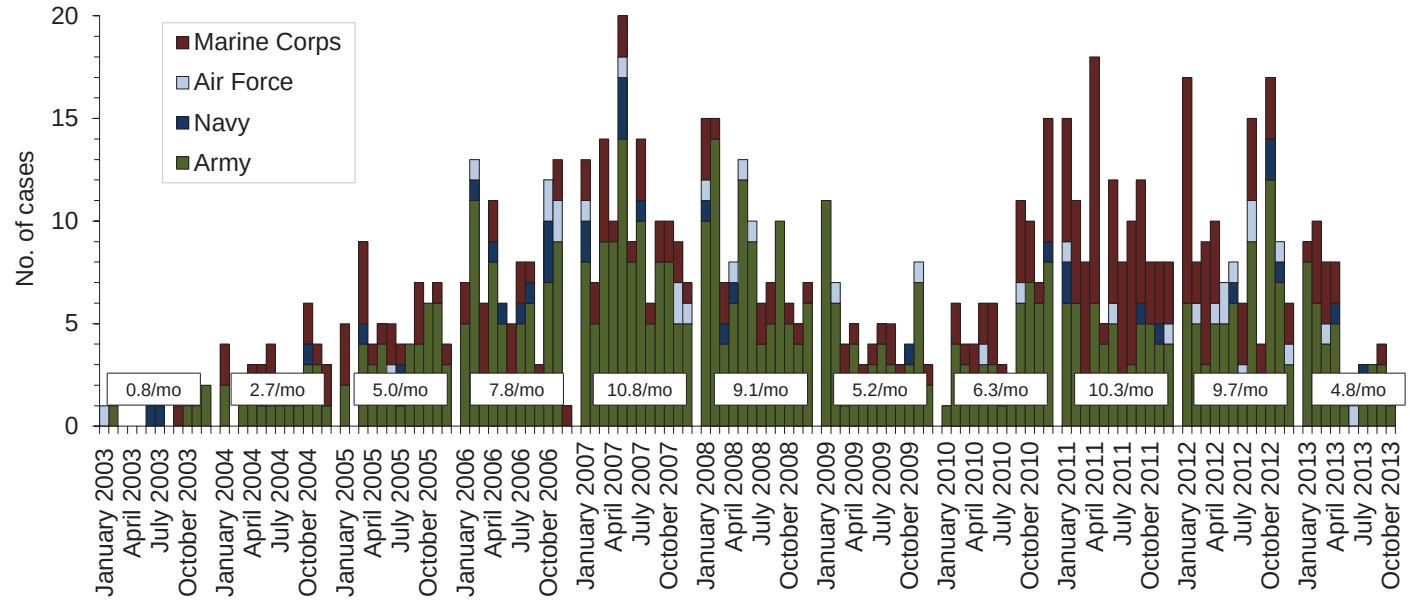
# Deployment-related conditions of special surveillance interest, U.S. Armed Forces, by month and service, January 2003-October 2013 (data as of 18 November 2013)

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

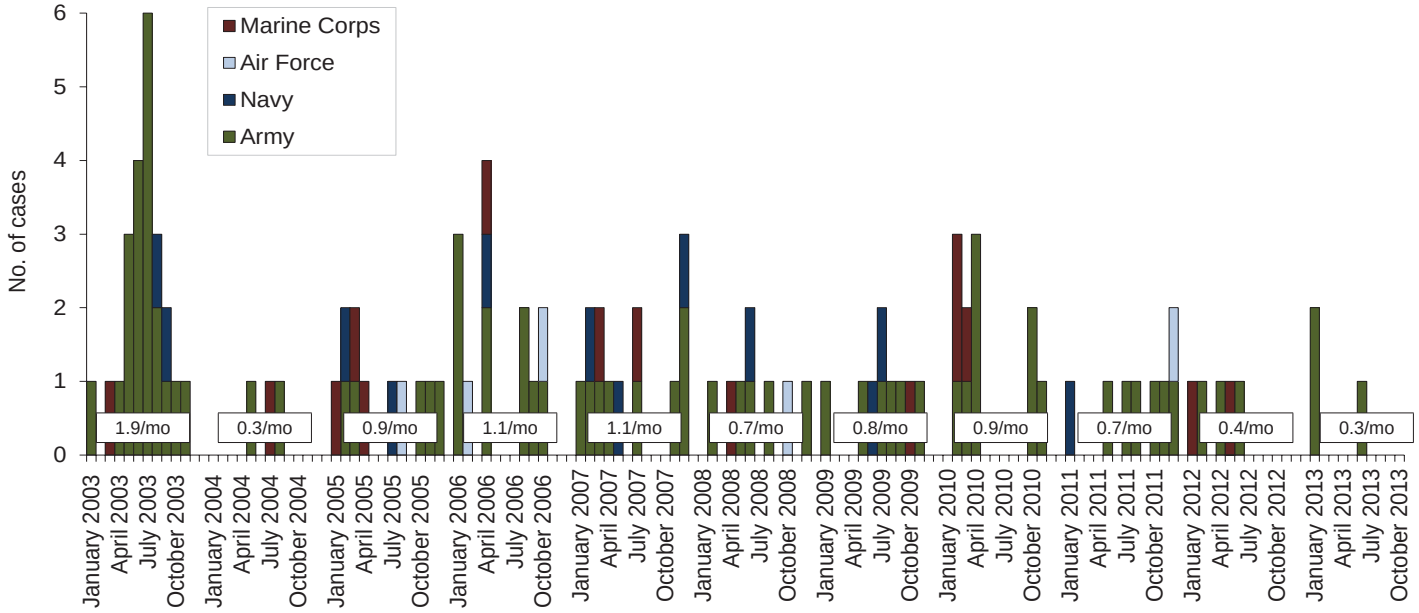
Heterotopic ossification (ICD-9: 728.12, 728.13, 728.19)[b]




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

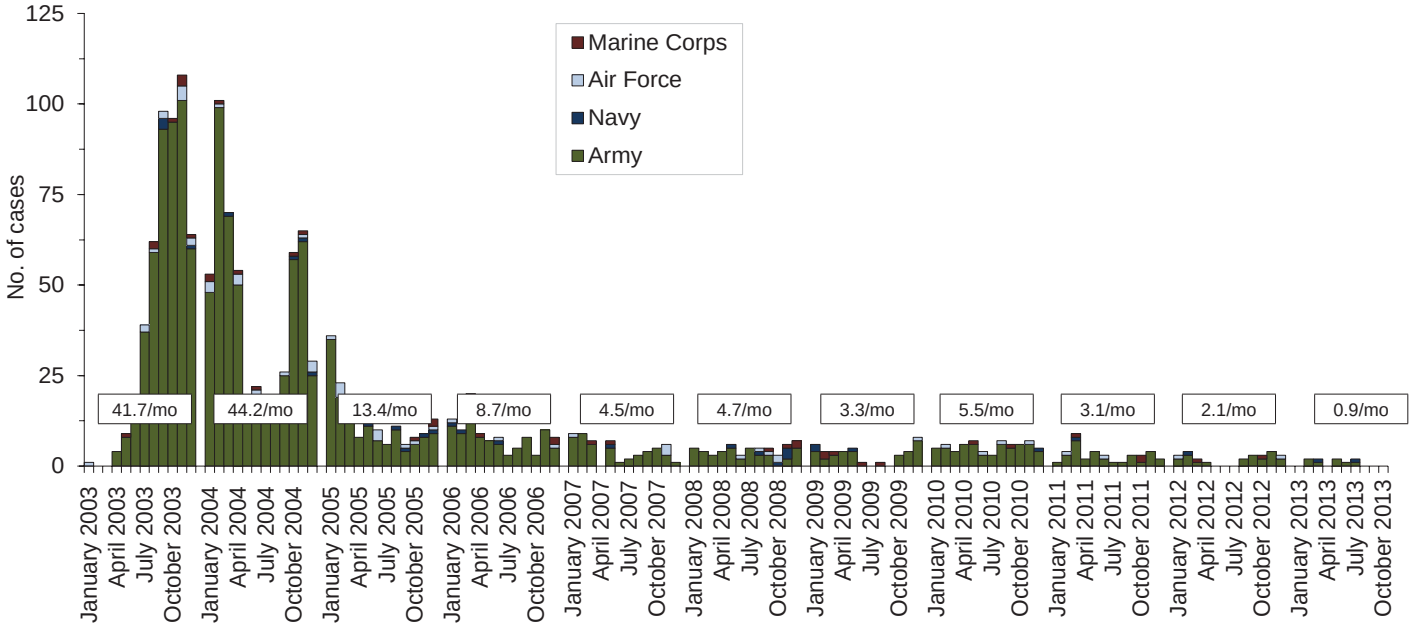
# Deployment-Related Conditions of Special Surveillance Interest, U.S. Armed Forces, by Month and Service, January 2003-October 2013 (data as of 18 November 2013)

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

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