

## Update: Heat Illness, Active Component, U.S. Armed Forces, 2017

**CE/CME**

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In 2017, there were 464 incident diagnoses of heat stroke and 1,699 incident diagnoses of heat exhaustion among active component service members. The overall crude incidence rates of heat stroke and heat exhaustion were 0.38 cases and 1.41 cases per 1,000 person-years, respectively. In 2017, subgroup-specific incidence rates of both heat stroke and heat exhaustion were highest among service members aged 19 years or younger, Asian/Pacific Islanders, Marine Corps and Army members, and those in combat-specific occupations. The rate of heat stroke was markedly higher among males than females. In contrast, the rate of heat exhaustion among females was similar to that among males. During 2013–2017, a total of 359 heat illnesses were documented among service members in Iraq and Afghanistan; 8.6% (n=31) were diagnosed as heat stroke. Commanders, small unit leaders, training cadre, and supporting medical personnel must ensure that military members whom they supervise and support are informed about risks, preventive countermeasures, early signs and symptoms, and first-responder actions related to heat illnesses.

The term “heat illness” refers to a group of disorders that occur when the elevation of core body temperature surpasses the compensatory limits of thermoregulation.<sup>1</sup> Heat illness is the result of environmental heat stress and/or exertion and represents a set of conditions that exist along a continuum from less severe (heat exhaustion) to potentially life-threatening (heat stroke).

Heat exhaustion is caused by the inability to maintain adequate cardiac output due to strenuous physical exertion and environmental heat stress.<sup>1,2</sup> Acute dehydration often accompanies heat exhaustion but is not required for the diagnosis.<sup>3</sup> Clinical criteria for heat exhaustion include core body temperature greater than 100.5°F/38°C and less than 104°F/40°C at the time of or immediately after exertion and/or heat exposure; physical collapse at the time of or shortly after physical exertion; and no significant dysfunction of the central nervous system. If any central nervous system dysfunction develops (e.g., dizziness, headache), it

is mild and rapidly resolves with rest and cooling measures (e.g., removal of unnecessary clothing, relocation to a cooled environment, and oral hydration with cooled, slightly hypotonic solutions).<sup>1-4</sup>

Heat stroke is a debilitating illness characterized clinically by severe hyperthermia (core body temperature of 104°F/40°C or greater), profound central nervous system dysfunction (e.g., delirium, seizures, coma), and additional organ and tissue damage.<sup>1,4,5</sup> The onset of heat stroke requires aggressive clinical treatments, including rapid cooling and supportive therapies such as fluid resuscitation to stabilize organ function.<sup>1,5</sup> The observed pathologic changes in several organ systems are thought to occur through a complex interaction between heat cytotoxicity, coagulopathies, and a severe systemic inflammatory response.<sup>1,5</sup> Multi-organ system failure is the ultimate cause of mortality due to heat stroke.<sup>5</sup>

Timely medical intervention can prevent milder cases of heat illness, such as heat exhaustion, from becoming severe

(e.g., heat stroke) and potentially life threatening. However, even with medical intervention, heat stroke may have lasting effects, including damage to the nervous system and other vital organs and decreased heat tolerance, making an individual more susceptible to subsequent episodes of heat illness.<sup>6-8</sup> Furthermore, the continued manifestation of multi-organ system dysfunction after heat stroke increases patients’ risk of mortality during the ensuing months and years.<sup>9,10</sup>

Strenuous physical activity for extended durations in occupational settings as well as during military operational and training exercises exposes service members to considerable heat stress due to high environmental heat and/or a high rate of metabolic heat production.<sup>11</sup> In some military settings, wearing needed protective clothing or equipment may make it biophysically difficult to dissipate body heat. The resulting body heat burden and associated cardiovascular strain limit exercise performance and increase the risk of heat-related illness.<sup>11,12</sup>

Over many decades, lessons learned during military training and operations in hot environments as well as a substantial body of literature have resulted in doctrine, equipment, and preventive measures that can significantly reduce the adverse health effects of military activities in hot weather.<sup>13-19</sup> Although numerous effective countermeasures are available, heat-related illness remains a significant threat to the health and operational effectiveness of military members and their units and accounts for considerable morbidity, particularly during recruit training in the U.S. military.<sup>11,20</sup>

In the Military Health System, the most serious heat-related illnesses are considered notifiable medical events. Notifiable cases of heat illness include heat exhaustion and heat stroke. All cases of heat illness that require medical intervention or result in change of duty status are reportable.<sup>4</sup>

This report summarizes not only reportable medical events of heat illnesses, but also heat illness–related hospitalizations and ambulatory visits among active component members during 2017 and compares them to the previous 4 years. Episodes of heat stroke and heat exhaustion are summarized separately.

## METHODS

The surveillance period was 1 January 2013 through 31 December 2017. The surveillance population included all individuals who served in the active component of the Army, Navy, Air Force, or Marine Corps at any time during the surveillance period. All data used to determine incident heat illness diagnoses were derived from records routinely maintained in the Defense Medical Surveillance System (DMSS). These records document both ambulatory encounters and hospitalizations of active component members of the U.S. Armed Forces in fixed military and civilian (if reimbursed through the Military Health System) treatment facilities worldwide. In-theater diagnoses of heat illness were identified from medical records of service members deployed to Southwest Asia/Middle East and whose healthcare encounters were documented in the Theater Medical Data Store (TMDS). Because heat illnesses represent a threat to the health of individual service members and to military training and operations, the Armed Forces require expeditious reporting of these reportable medical events through one of the service-specific electronic reporting systems; these reports are routinely transmitted and incorporated into the DMSS.

For this analysis, a case of heat illness was defined as an individual with 1) a hospitalization or outpatient medical encounter with a primary (first-listed) or secondary (second-listed) diagnosis of heat stroke (ICD-9: 992.0; ICD-10: T67.0\*) or heat exhaustion (ICD-9: 992.3–992.5; ICD-10: T67.3\*–T67.5\*); or 2) a reportable medical event record of heat exhaustion or heat stroke.<sup>21</sup> It is important to note that previous *MSMR* analyses included diagnosis codes

for other and unspecified effects of heat and light (ICD-9: 992.8 and 992.9; ICD-10: T67.8\* and T67.9\*) within the heat illness category “other heat illnesses.” These codes were excluded from the current analysis. If an individual had a diagnosis for both heat stroke and heat exhaustion during a given year, only one diagnosis was selected prioritizing heat stroke over heat exhaustion. Encounters for each individual within each calendar year then were prioritized in terms of record source: hospitalizations > reportable events > ambulatory visits.

For surveillance purposes, a “recruit trainee” was defined as an active component service member (grades E1–E4) who was assigned to one of the Services’ nine recruit training locations (per the individual’s initial military personnel record). For this report, each service member was considered a recruit trainee for the period of time corresponding to the usual length of recruit training in his or her service. Recruit trainees were considered a separate category of enlisted service members in summaries of heat illnesses by military grade overall.

Records of medical evacuations from the U.S. Central Command (CENTCOM) area of responsibility (AOR) (i.e., Iraq, Afghanistan) to a medical treatment facility outside the CENTCOM AOR were analyzed separately. Evacuations were considered case-defining if affected service members had at least one inpatient or outpatient heat illness medical encounter in a permanent military medical facility in the U.S. or Europe from 5 days before to 10 days after their evacuation dates.

The new electronic health record for the Military Health System, MHS GENESIS, was implemented at several military treatment facilities during 2017. Medical data from sites that are using MHS GENESIS are not available in DMSS. These sites include Naval Hospital Oak Harbor, Naval Hospital Bremerton, Air Force Medical Services Fairchild, and Madigan Army Medical Center. Therefore, medical encounter and person-time data for individuals seeking care at one of these facilities during 2017 were not included in this analysis.

## RESULTS

In 2017, there were 464 incident cases of heat stroke and 1,699 incident cases of heat exhaustion among active component service members (**Table 1**). The overall crude incidence rates of heat stroke and heat exhaustion were 0.38 cases and 1.41 cases per 1,000 person-years (p-yrs), respectively.

Crude (unadjusted) annual incidence rates of heat stroke increased steadily from 0.24 cases per 1,000 p-yrs in 2013 to 0.38 cases per 1,000 p-yrs in 2016 and 2017 (**Figure 1**). In 2017, there were more heat stroke–related hospitalizations than in 2016 but similar numbers of ambulatory visits. Crude annual incidence rates of heat exhaustion ranged from a low of 1.12 cases per 1,000 p-yrs in 2014 to a peak of 1.43 cases per 1,000 p-yrs in 2016, after which the rate remained relatively stable at 1.41 cases per 1,000 p-yrs in 2017 (**Figure 2**). During the 5-year surveillance period, the numbers of heat exhaustion–related hospitalizations and the proportions that they represented of the total heat exhaustion cases remained relatively stable (range 44–60; 2.6%–4.2%); however, the proportions of total heat exhaustion cases represented by ambulatory visits increased from 57.0% in 2013 to 80.8% in 2017.

In 2017, subgroup-specific incidence rates of heat stroke were highest among males and service members aged 19 years or younger, Asian/Pacific Islanders, Marine Corps and Army members, recruit trainees, and those in combat-specific occupations (**Table 1**). The incidence rate of heat stroke was 38.2% higher among service members in the Marine Corps than among those in the Army; the Army rate was nearly 6-fold the Navy rate and 11-fold the Air Force rate; and the rate among females was 40.1% lower than the rate among males. There were only 18 cases of heat stroke reported among recruit trainees, but their incidence rate was more than one and a half times that of other enlisted members and officers.

In contrast to the heat stroke findings, the crude incidence rate of heat exhaustion among females was similar to that among males (**Table 1**). In 2017, subgroup-specific

**TABLE 1.** Incident cases<sup>a</sup> and incidence rates<sup>b</sup> of heat illness, active component, U.S. Armed Forces, 2017

|                                   | Heat stroke |                   | Heat exhaustion |                   | Total heat illness diagnoses |                   |
|-----------------------------------|-------------|-------------------|-----------------|-------------------|------------------------------|-------------------|
|                                   | No.         | Rate <sup>b</sup> | No.             | Rate <sup>b</sup> | No.                          | Rate <sup>b</sup> |
| Total                             | 464         | 0.38              | 1,699           | 1.41              | 2,163                        | 1.79              |
| <b>Sex</b>                        |             |                   |                 |                   |                              |                   |
| Male                              | 416         | 0.41              | 1,430           | 1.41              | 1,846                        | 1.82              |
| Female                            | 48          | 0.25              | 269             | 1.38              | 317                          | 1.62              |
| <b>Age group</b>                  |             |                   |                 |                   |                              |                   |
| <20                               | 68          | 0.72              | 499             | 5.29              | 567                          | 6.02              |
| 20–24                             | 196         | 0.51              | 699             | 1.83              | 895                          | 2.34              |
| 25–29                             | 110         | 0.40              | 264             | 0.96              | 374                          | 1.35              |
| 30–34                             | 56          | 0.29              | 129             | 0.66              | 185                          | 0.95              |
| 35–39                             | 19          | 0.14              | 70              | 0.50              | 89                           | 0.64              |
| 40+                               | 15          | 0.12              | 38              | 0.31              | 53                           | 0.43              |
| <b>Race/ethnicity</b>             |             |                   |                 |                   |                              |                   |
| Non-Hispanic white                | 269         | 0.39              | 947             | 1.37              | 1,216                        | 1.76              |
| Non-Hispanic black                | 81          | 0.41              | 325             | 1.63              | 406                          | 2.04              |
| Hispanic                          | 66          | 0.35              | 252             | 1.35              | 318                          | 1.71              |
| Asian/Pacific Islander            | 28          | 0.59              | 101             | 2.11              | 129                          | 2.70              |
| Other/unknown                     | 20          | 0.23              | 74              | 0.87              | 94                           | 1.10              |
| <b>Service</b>                    |             |                   |                 |                   |                              |                   |
| Army                              | 265         | 0.60              | 961             | 2.19              | 1,226                        | 2.80              |
| Navy                              | 29          | 0.10              | 109             | 0.39              | 138                          | 0.50              |
| Air Force                         | 17          | 0.05              | 134             | 0.43              | 151                          | 0.49              |
| Marine Corps                      | 153         | 0.84              | 495             | 2.70              | 648                          | 3.54              |
| <b>Military status</b>            |             |                   |                 |                   |                              |                   |
| Recruit                           | 18          | 0.61              | 306             | 10.45             | 324                          | 11.07             |
| Enlisted                          | 368         | 0.38              | 1,279           | 1.33              | 1,647                        | 1.71              |
| Officer                           | 78          | 0.36              | 114             | 0.52              | 192                          | 0.88              |
| <b>Military occupation</b>        |             |                   |                 |                   |                              |                   |
| Combat-specific <sup>c</sup>      | 170         | 1.07              | 497             | 3.12              | 667                          | 4.18              |
| Armor/motor transport             | 8           | 0.19              | 66              | 1.58              | 74                           | 1.77              |
| Pilot/air crew                    | 7           | 0.16              | 7               | 0.16              | 14                           | 0.31              |
| Repair/engineering                | 63          | 0.18              | 265             | 0.77              | 328                          | 0.96              |
| Communications/intelligence       | 66          | 0.26              | 291             | 1.14              | 357                          | 1.40              |
| Health care                       | 34          | 0.32              | 102             | 0.95              | 136                          | 1.26              |
| Other/unknown                     | 116         | 0.45              | 471             | 1.84              | 587                          | 2.29              |
| <b>Home of record<sup>d</sup></b> |             |                   |                 |                   |                              |                   |
| Midwest                           | 97          | 0.44              | 307             | 1.40              | 404                          | 1.85              |
| Northeast                         | 53          | 0.34              | 198             | 1.27              | 251                          | 1.61              |
| South                             | 198         | 0.38              | 793             | 1.53              | 991                          | 1.91              |
| West                              | 106         | 0.38              | 376             | 1.36              | 482                          | 1.74              |
| Other/unknown                     | 10          | 0.25              | 25              | 0.63              | 35                           | 0.88              |

<sup>a</sup>One case per person per year

<sup>b</sup>Number of cases per 1,000 person-years

<sup>c</sup>Infantry/artillery/combat engineering

<sup>d</sup>As self-reported at time of entry into service

incidence rates of heat exhaustion were notably higher among service members aged 19 years or younger, Asian/Pacific Islanders, Marine Corps and Army members, recruit trainees, and service members in combat-specific occupations.

### Heat illnesses by location

During the 5-year surveillance period, a total of 10,458 heat-related illnesses were diagnosed at more than 250 military installations and geographic locations worldwide.

Less than 5% of the total heat illness cases occurred outside of the U.S. (n=440). Four Army installations accounted for close to one-third (32.8%) of all heat illnesses during the period (Fort Benning, GA [n=1,328]; Fort Bragg, NC [n=1,059]; Fort Campbell, KY [n=606]; and Fort Jackson, SC [n=442]); six other locations accounted for an additional one-quarter (25.3%) of heat illness events (Marine Corps Base Camp Lejeune/Cherry Point, NC [n=682]; Marine Corps Recruit Depot Parris Island/Beaufort, SC [n=518]; Marine Corps Base Camp Pendleton, CA [n=432]; Fort Polk, LA [n=428]; NMC San Diego, CA [n=313]; and Okinawa, Japan [n=271]). Of the 10 locations with the most heat illness events, seven are located in the southeastern U.S. (Table 2). The 17 locations with more than 100 cases of heat illness accounted for 71.4% of all active component cases during 2013–2017.

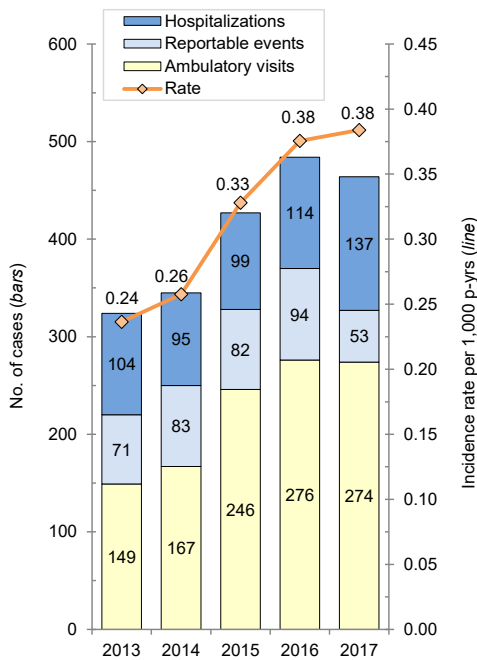
### Heat illnesses in Iraq and Afghanistan

During the 5-year surveillance period, a total of 359 heat illnesses were diagnosed and treated in Iraq and Afghanistan (Figure 3). Of the total cases of heat illness, 8.6% (n=31) were diagnosed as heat stroke. Deployed service members who were affected by heat illnesses were most frequently male (n=297; 82.7%); non-Hispanic white (n=215; 59.9%); aged 20–24 years (n=177; 49.3%); in the Army (n=206; 57.4%); enlisted (n=343; 95.5%); and in repair/engineering (n=123; 34.3%) or combat-specific (n=95; 26.5%) occupations (data not shown). During the surveillance period, four service members were medically evacuated for heat illnesses from Iraq or Afghanistan; all of the evacuations took place in the summer months (May–September).

### EDITORIAL COMMENT

This annual update of heat illnesses among service members in the active component documented that the unadjusted annual incidence rates of heat stroke increased steadily between 2013 and 2016 with relatively little change in rates between

**FIGURE 1.** Incident cases<sup>a</sup> and incidence rates of heat stroke, by source of report and year of diagnosis, active component, U.S. Armed Forces, 2013–2017

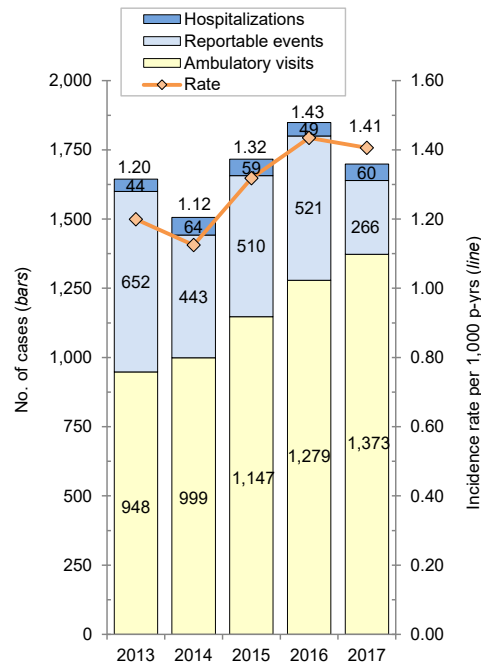


<sup>a</sup>Diagnosis codes were prioritized by severity and record source (heat stroke > heat exhaustion; hospitalizations > reportable events > ambulatory visits)

2016 and 2017. The crude annual incidence rate of heat exhaustion in 2017 was comparable to the rate in 2016.

There are significant limitations to this update that should be considered when interpreting the results. Similar heat-related clinical illnesses are likely managed differently and reported with different diagnostic codes at different locations and in different clinical settings. Such differences undermine the validity of direct comparisons of rates of nominal heat stroke and heat exhaustion events across locations and settings. Also, heat illnesses during training exercises and deployments that are treated in field medical facilities are not completely ascertained as cases for this report. In addition, it should be noted that the guidelines for mandatory reporting of heat illnesses were modified in the 2017 revision of the Armed Forces guidelines and case definitions for reportable medical events.<sup>4</sup> In this updated version of the guidelines and case definitions, the heat injury category

**FIGURE 2.** Incident cases<sup>a</sup> and incidence rates of heat exhaustion, by source of report and year of diagnosis, active component, U.S. Armed Forces, 2013–2017



<sup>a</sup>Diagnosis codes were prioritized by severity and record source (heat stroke > heat exhaustion; hospitalizations > reportable events > ambulatory visits)

was removed, leaving only case classifications for heat stroke and heat exhaustion. To compensate for such possible variation in reporting, the analysis for this update, as in previous years, included cases identified in DMSS records of ambulatory care and hospitalizations using a consistent set of ICD-9/ICD-10 codes for the entire surveillance period. However, it also is important to note that the exclusion of diagnosis codes for other and unspecified effects of heat and light (formerly included within the heat illness category “other heat illnesses”) in the current analysis precludes the direct comparison of numbers and rates of cases of heat exhaustion to the numbers and rates of “other heat illnesses” reported in previous *MSMR* updates.

As has been noted in previous *MSMR* heat illness updates, results indicate that a sizable proportion of cases identified through DMSS records of hospitalizations and ambulatory visits did not prompt mandatory reports through the reporting

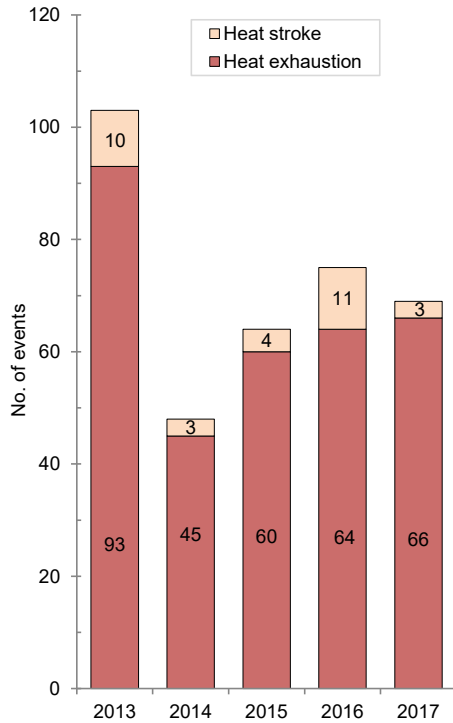
**TABLE 2.** Heat illness events,<sup>a</sup> by location of diagnosis/report, active component, U.S. Armed Forces, 2013–2017

| Location of diagnosis             | No.    | % total |
|-----------------------------------|--------|---------|
| Fort Benning, GA                  | 1,328  | 12.7    |
| Fort Bragg, NC                    | 1,059  | 10.1    |
| MCB Camp Lejeune/Cherry Point, NC | 682    | 6.5     |
| Fort Campbell, KY                 | 606    | 5.8     |
| MCRD Parris Island/Beaufort, SC   | 518    | 5.0     |
| Fort Jackson, SC                  | 442    | 4.2     |
| MCB Camp Pendleton, CA            | 432    | 4.1     |
| Fort Polk, LA                     | 428    | 4.1     |
| NMC San Diego, CA                 | 313    | 3.0     |
| Okinawa, Japan                    | 271    | 2.6     |
| Fort Hood, TX                     | 254    | 2.4     |
| MCB Quantico, VA                  | 239    | 2.3     |
| Fort Stewart, GA                  | 228    | 2.2     |
| Fort Shafter, HI                  | 172    | 1.6     |
| NH Twentynine Palms, CA           | 168    | 1.6     |
| Fort Leonard Wood, MO             | 166    | 1.6     |
| JBSA-Lackland AFB, TX             | 166    | 1.6     |
| Elgin AFB, FL                     | 93     | 0.9     |
| Fort Riley, KS                    | 87     | 0.8     |
| Fort Irwin, CA                    | 85     | 0.8     |
| All other locations               | 2,721  | 26.0    |
| Total                             | 10,458 | 100.0   |

<sup>a</sup>One heat injury per person per year  
MCB, Marine Corps Base; MCRD, Marine Corps Recruit Depot; NMC, Naval Medical Center; JBSA, Joint Base San Antonio; AFB, Air Force Base; NH, Naval Hospital

system.<sup>20</sup> However, the record source prioritization rule (hospitalizations > reportable events > ambulatory visits) employed in this analysis imposes limitations as to what can be said about the true magnitude of the observed discrepancy in the numbers of reportable events and medical encounters for both types of heat illness. To address this limitation in future analyses, it will be important to ascertain the overlap between hospitalizations and reportable events and the overlap between reportable events and outpatient encounters. It is possible that cases of heat illness, whether diagnosed during an inpatient or outpatient encounter, were not reported as reportable medical events because treatment providers were not attentive to the criteria for reporting

**FIGURE 3.** Numbers of heat illnesses diagnosed in Iraq/Afghanistan, active component, U.S. Armed Forces, 2013–2017



or because of ambiguity in interpreting the criteria (e.g., the heat illness did not result in a change in duty status; for heat stroke, core body temperature measured during/immediately after exertion or heat exposure was not available). Underreporting is especially concerning for cases of heat stroke because it may reflect insufficient attentiveness to the need for prompt recognition of cases of this dangerous illness and for timely intervention at the local level to prevent additional cases.

In spite of its limitations, this report documents that heat illnesses are a significant and persistent threat to both the health of U.S. military members and the effectiveness of military operations. Of all military members, the youngest and most inexperienced Marines and soldiers (particularly those training at installations in the southeastern U.S.) are at highest risk of heat illnesses—including heat stroke, exertional hyponatremia, and exertional

rhabdomyolysis (see the other articles in this issue of the *MSMR*).

Commanders, small unit leaders, training cadre, and supporting medical personnel—particularly at recruit training centers and installations with large combat troop populations—must ensure that military members whom they supervise and support are informed regarding risks, preventive countermeasures (e.g., water consumption), early signs and symptoms, and first-responder actions related to heat illnesses.<sup>13–19</sup> Leaders should be aware of the dangers of insufficient hydration on the one hand and excessive water intake on the other; they must have detailed knowledge of, and rigidly enforce countermeasures against, all types of heat illnesses.

Policies, guidance, and other information related to heat illness prevention and treatment among U.S. military members are available online here:

<https://phc.amedd.army.mil/topics/discond/hipss/Pages/Heat-Related-Illness-Prevention.aspx>

[www.logcom.marines.mil/Centers/Special-Staff/I-E-and-Safety-Office/Installations/Heat-Prevention/](http://www.logcom.marines.mil/Centers/Special-Staff/I-E-and-Safety-Office/Installations/Heat-Prevention/)

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**Key points**

- The unadjusted annual incidence rates of heat stroke increased steadily between 2013 and 2016 with relatively little change in rates between 2016 and 2017.
- The crude annual incidence rate of heat exhaustion in 2017 was comparable to the rate in 2016.
- Similar to findings from previous *MSMR* updates, subgroup-specific incidence rates of heat illness in 2017 were highest among males and service members aged 19 years or younger, Asian/Pacific Islanders, Marine Corps and Army members, recruit trainees, and those in combat-specific occupations.

**Learning objectives**

1. The reader will differentiate between the clinical criteria used to diagnose heat exhaustion and those used to diagnose heat stroke.
2. The reader will identify factors, such as sex and military occupation, associated with heat illness.
3. The reader will explain the challenges associated with tracking heat illness in the military.

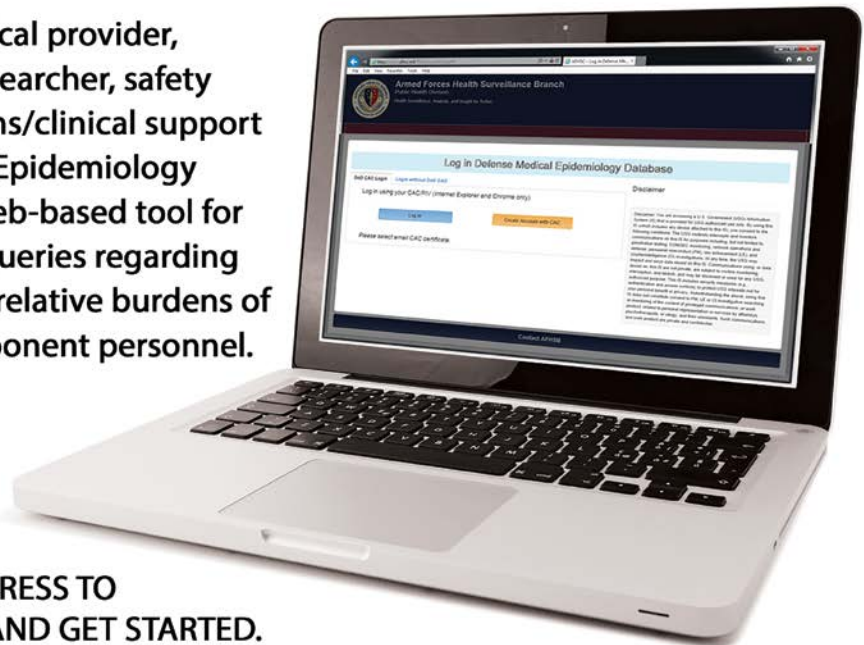
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# Work/Rest Times and Fluid Replacement Guide

| Heat Category | WBGT Index (°F) | Easy Work           |                            | Moderate Work       |                            | Hard Work           |                            |
|---------------|-----------------|---------------------|----------------------------|---------------------|----------------------------|---------------------|----------------------------|
|               |                 | Work/Rest (minutes) | Fluid Intake (quarts/hour) | Work/Rest (minutes) | Fluid Intake (quarts/hour) | Work/Rest (minutes) | Fluid Intake (quarts/hour) |
| 1             | 78° - 81.9°     | NL                  | 1/2                        | NL                  | 3/4                        | 40/20 (70)*         | 3/4 (1)*                   |
| 2 (GREEN)     | 82° - 84.9°     | NL                  | 1/2                        | 50/10 (150)*        | 3/4 (1)*                   | 30/30 (65)*         | 1 (1 1/4)*                 |
| 3 (YELLOW)    | 85° - 87.9°     | NL                  | 3/4                        | 40/20 (100)*        | 3/4 (1)*                   | 30/30 (55)*         | 1 (1 1/4)*                 |
| 4 (RED)       | 88° - 89.9°     | NL                  | 3/4                        | 30/30 (80)*         | 3/4 (1 1/4)*               | 20/40 (50)*         | 1 (1 1/4)*                 |
| 5 (BLACK)     | > 90°           | 50/10 (180)*        | 1                          | 20/40 (70)*         | 1 (1 1/4)*                 | 10/50 (45)*         | 1 (1 1/2)*                 |

NL = No limit to work time per hour.

\*Use the amounts in parentheses for continuous work when rest breaks are not possible. Leaders should ensure several hours of rest and rehydration time after continuous work.

This guidance will sustain performance and hydration for at least 4 hours of work in the specified heat category. Fluid needs can vary based on individual differences (± 1/4 qt/hr) and exposure to full sun or full shade (± 1/4 qt/hr). Rest means minimal physical activity (sitting or standing) in the shade if possible. Body Armor - Add 5°F to WBGT index in humid climates. NBC (MOPP 4) - Add 10°F (Easy Work) or 20°F (Moderate or Hard Work) to WBGT Index.

**CAUTION:** Hourly fluid intake should not exceed 1 1/2 qts. Daily fluid intake should not exceed 12 qts.



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