

BRIEF REPORT

Exertional Heat-Related Illnesses at the Grand Canyon National Park, 2004–2009

CDR Rebecca S. Noe, MN, MPH, FNP; Ekta Choudhary, MS, MPH, PhD; LCDR Jennifer Cheng-Dobson, MPH; Amy F. Wolkin, MSPH; CDR Sara B. Newman, DrPH, MCP

From the Division of Environmental Hazards and Health Effects, National Center for Environmental Health, Centers for Disease Control and Prevention, Chamblee, GA (Commander Noe, Dr Choudhary, and Ms Wolkin); and Office of Risk Management, National Park Service, Washington, DC (Lieutenant Commander Cheng-Dobson and Commander Newman).

Background.—The Grand Canyon National Park has approximately 4 million visitors between April and September each year. During this period, outdoor activity such as hiking is potentially hazardous owing to extreme heat, limited shade, and steep, long ascents. Given the high visitation and the public health interest in the effects of extreme heat, this study calculated morbidity rates and described heat-related illness (HRI) among visitors.

Methods.—We conducted a retrospective cross-sectional study from April 1 through September 30, during 2004–2009. From a review of Ranger Emergency Medical Services (EMS) incident report files, we extracted information on those that met the case definition of greater than 1 hour of outdoor heat exposure with an HRI assessment or diagnosis, HRI self-report, or signs or symptoms of HRI without another etiology noted. Visitor and temperature data were obtained from respective official sources.

Results.—Grand Canyon EMS responded to 474 nonfatal and 6 fatal HRI cases, with the majority (84%) being US residents, 29% from Western states. Of the nonfatal cases, 51% were women, the median age was 43 years (range, 11–83 years), and 18% reported a cardiovascular condition. Clinical HRI assessments included dehydration (25%), heat exhaustion (23%), and suspected hyponatremia (19%). Almost all (90%) were hiking; 40% required helicopter evacuation. The highest HRI rates were seen in May.

Conclusions.—HRI remains a public health concern at the Grand Canyon. High-risk evacuations and life-threatening conditions were found. Majority were hikers, middle-aged adults, and US residents. These findings support the park's hiker HRI prevention efforts and use of park EMS data to measure HRI.

Key words: heat illness, hiking, National Park, Grand Canyon, wilderness, emergency medical services

Background

Annually, 4.4 million people visit the Grand Canyon National Park (canyon), making it one of the most visited national parks in the United States.¹ The majority visit during April through September when air temperatures can exceed 100°F (37°C) on the rim and 120°F (44°C) at the bottom of the canyon.^{1–3} Most visitors view the canyon from the rim overlooks, although an

average of 190,000 visitors camp overnight below the rim and another estimated 400,000 visitors attempt a day hike into the canyon during this period.^{2,3} The canyon's topography makes hiking extremely strenuous because of the long (7–14 miles) and steep (4,000- to 7,000-foot elevation change) trails that have sparse vegetation available for shade, limited potable water, and extreme heat during the summer months.¹ Consequently, hiking—especially below the rim—can become a potentially serious, even life-threatening event, owing to the prolonged exposure to extremely high ambient temperatures while engaged in strenuous physical activity.^{1,3,4}

Heat-related illnesses (HRI) range from heat syncope and heat cramps to the most common type, heat exhaustion.^{5–7} Heat stroke is the most serious life-threatening condition, and exertional heat stroke (EHS) has been documented among athletes, military recruits,

Disclaimer: The findings and conclusions in this manuscript are those of the author(s) and do not necessarily represent the views of the Centers for Disease Control and Prevention or the Agency for Toxic Substances and Disease Registry.

Corresponding author: CDR Rebecca S. Noe MN, MPH, FNP, United States Public Health Service, National Center for Environmental Health, Centers for Disease Control and Prevention, 4770 Buford Hwy, NE, Chamblee, GA 30341 (e-mail: rhn9@cdc.gov).

and wilderness enthusiasts engaged in long periods of strenuous physical activity in a hot environment.^{3,5-7} Although similar to classic heat stroke in clinical presentation, EHS often results in rapid onset of severe outcomes such as hyponatremia, acute renal failure, rhabdomyolysis, disseminated intravascular coagulation, and death.⁵⁻⁷ The risk of exertional HRI may increase as a result of lack of heat and altitude acclimatization, poor conditioning, insufficient shade, advanced age, presence of a chronic disease and certain medications, and dehydration caused by significant sweat loss, inadequate water intake, or both.^{5,6} Although HRI is recognized as a serious issue at the canyon and prevention programs have been in place since 1997, the true magnitude, description, and temporal trends of the problem are not well documented.^{3,4} This study calculated rates and describes the epidemiology of HRI among visitors treated by the canyon's Emergency Medical Services (EMS) during a 6-year period to provide the park with a baseline to examine ongoing prevention programs.

Methods

STUDY DESIGN AND DATA SOURCES

This was a retrospective, cross-sectional study of HRI cases among park visitors from April 1 through September 30 of 2004–2009. A total of 5547 EMS case incident reports were identified, and after we excluded those with a clear non-HRI etiology (eg, motor vehicle crashes, upper respiratory infections), 3360 reports remained. Ranger mortality reports were reviewed for deaths associated with heat exposure. These sources captured only those incidents responded to by the National Park Service (NPS) within the park boundaries.

CASE-PATIENT IDENTIFICATION

Persons whom EMS treated (or found if deceased) were eligible for inclusion into the study if they were a visitor during the study period and had a documented outdoor heat exposure of more than 1 hour within the previous 24 hours. To be a case there need to be one of the following documented indicator(s) of heat illness: 1) paramedic assessment of HRI; 2) self-report or phrases that indicated “heat” (eg, “overheated, dehydration”) as a contributing factor; or 3) at least 2 signs and symptoms consistent with HRI not associated with another etiology (eg, nausea and vomiting while hiking). This tiered approach was used to systematically review the EMS case incident reports, which varied in format (eg, SOAP [subjective, objective, assessment, and plan] documentation vs narratives), terminology, and completeness. Excluded from the study were canyon residents such as

NPS employees, concession employees, volunteers, and family members. These groups were likely acclimatized to and more cognizant of the heat and the strenuous hiking environment.

DATA COLLECTION AND REPORTING

The 3360 files were reviewed to determine those that met the case definition (described above). Any questions on inclusion or exclusion of cases were discussed among the study team. Information on demographics, activity type, clinical assessment, and medical history was collected on a standardized form. Six age categories (<5 years, 5–17 years, 18–25 years, 26–49 years, 50–65 years, and 65 years and older) were created. Based on the state and country of residence, visitors were dichotomized into non-US residents and US residents. US residents were further categorized into the four US Census regions: West, South, Midwest, and Northeast. A categorical variable described the trail location within the canyon (eg, North and South Rim trails) where a case-patient was located by EMS.

The medical terminology of the clinical assessment(s) varied, although 8 categories emerged: dehydration, heat cramps, heat syncope, heat exhaustion, heat-related illness not specified, suspected hyponatremia, suspected rhabdomyolysis, and other (eg, suspected renal failure, heat stroke). The heat-related illness not specified category was established to collate the nonspecific HRI clinical assessment(s) such as “heat-related illness,” “heat stress,” and “heat sickness.” Because the majority of case-patients had multiple clinical assessments without a primary assessment clearly indicated, frequencies were calculated by tallying the number of times each assessment category was recorded in the study population.

Preexisting chronic medical conditions and medications that have been associated with HRI were identified. Chronic conditions were organized by the body system(s). In some of the records, current medication(s) were recorded as drug descriptor (eg, “high BP [blood pressure] pill”) rather than by a specific drug name or class. To develop a classification scheme, we used Goodman & Gilman's pharmacology textbook *The Pharmacological Basis of Therapeutics*. Using this book's therapeutic groupings provided a framework to assign similar medication descriptions (eg, high BP pill) and medications (eg, atenolol) into the applicable category based on specific therapeutic use (eg, “regulate cardiovascular function”). Six categories were used: 1) cardiovascular drugs and therapies, including treatment of hypertension, hypercholesterolemia, and hyperlipidemia; 2) pain medications (eg, opioids, analgesia); 3) anti-inflammatory

Download English Version:

<https://daneshyari.com/en/article/2614752>

Download Persian Version:

<https://daneshyari.com/article/2614752>

[Daneshyari.com](https://daneshyari.com)