

Extreme Heat Exposure: Access and Barriers to Cooling Centers — Maricopa and Yuma Counties, Arizona, 2010–2020

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Extreme heat exposure increases the risk for heat-related illnesses (HRIs) and deaths, and comprehensive strategies to prevent HRIs are increasingly important in a warming climate (1). An estimated 702 HRI-associated deaths and 67,512 HRI-associated emergency department visits occur in the United States each year (2,3). In 2020, Phoenix and Yuma, Arizona, experienced a record 145 and 148 days, respectively, of temperatures >100°F (37.8°C), and a record 522 heat-related deaths occurred in the state. HRIs are preventable through individual and community-based strategies^{*,†}; cooling centers,[§] typically air-conditioned or cooled buildings designated

as sites to provide respite and safety during extreme heat, have been established in Maricopa and Yuma counties to reduce HRIs among at-risk populations, such as older adults. This analysis examined trends in HRIs by age during 2010–2020 for Maricopa and Yuma counties and data from a survey of older adults related to cooling center availability and use in Yuma County during 2018–2019. Data from CDC's Social Vulnerability Index (SVI) were also used to overlay cooling center locations with SVI scores. During 2010–2020, heat days, defined as days with an excessive heat warning issued by

* Individual and community-based prevention strategies are enhanced when they include comprehensive approaches to address the structural and social conditions that influence health disparities. The Vital Conditions for Health and Well-Being Framework outlines seven essential domains to consider in a comprehensive health prevention strategy: humane housing, reliable transportation, meaningful work and wealth, lifelong learning, basic needs for health and safety, belonging and civic muscle (e.g., public participation and collaboration), and thriving natural world. A person or community has a greater likelihood of increasing heat resilience and protect against elevated risk for heat-related mortality or morbidity when they are able to experience the optimal conditions for all of these domains.

† Arizona Department of Health Services and Yuma and Maricopa counties have deployed several strategies to reduce HRI inequities. Yuma County survey data helped identify priority areas for new cooling center locations posted as an online map and those that might be improved through SVI overlays. Bilingual fact sheets on HRI and resources on social services to check on neighbors not using air conditioning were posted to the Yuma County website. Public service announcements on cooling centers were aired on the county's public television channel. Maricopa County Department of Public Health, which has contributed substantial findings to the body of evidence on cooling center usage from past evaluations, is planning a cooling center evaluation for 2023 that will help provide additional evidence to reduce barriers to cooling center use and help with choosing appropriate adaptive strategies. <https://adhsgis.maps.arcgis.com/apps/webappviewer/index.html?id=2e12ca8b1d6540f0ae8de41e93936efb>; <https://www.yumacountyaz.gov/government/health-district/divisions/emergency-preparedness-program/hot-news-how-you-can-prepare-for-the-heat>; <https://doi.org/10.1175/WCAS-D-16-0033.1>

§ Cooling centers might be a government-owned building such as a library or school, an existing community, religious, or recreation center, or a private business such as a coffee shop, shopping mall, or movie theater.

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the National Weather Service Phoenix Office,[‡] for any part of Maricopa and Yuma counties (4), increased in both Maricopa County (1.18 days per year) and Yuma County (1.71 days per year) on average. Adults aged ≥65 years had higher rates of HRI hospitalization compared with those aged <65 years. In a survey of 39 adults aged ≥65 years in Yuma County, 44% reported recent HRI symptoms, and 18% reported electricity cost always or sometimes constrained their use of air conditioning. Barriers to cooling center access among older adults include awareness of location and transportation. Collaboration among diverse community sectors and health profession education programs is important to better prepare for rising heat exposure and HRIs. States and communities can implement adaptation and evaluation strategies to mitigate and assess heat risk, such as the use of cooling centers to protect communities disproportionately affected by HRI during periods of high temperatures.

Hospital discharge records for Maricopa and Yuma counties, excluding U.S. Department of Defense, Veterans' Affairs, and Indian Health Service facilities, were used to identify HRI-associated inpatient admissions (hospitalizations) during 2010–2020. HRI hospitalizations were defined as those in an

Arizona resident during months when HRIs are most often observed (May–September) with one or more codes related to excessive natural heat or sunlight exposure in primary or other diagnoses from the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD-9-CM) (992, E900.0, and E900.9) or *International Classification of Diseases, Tenth Revision, Clinical Modification* (ICD-10-CM) (T67, X30, and X32).^{**} Data were assessed for adults aged ≥65 and <65 years and presented as inpatient admissions per 100,000 population within each cohort. The two age groups were compared using rate ratios. Heat days were summarized by annual average trends assessed using linear regression. Data were analyzed using SAS (version 9.4; SAS Institute).

Yuma County cooling center evaluation data from the Arizona Department of Health Services' Climate-Ready States and Cities Initiative implemented during the summers of 2018 and 2019 were used to evaluate risk perception and awareness of resources among older adults (5). A survey was conducted among participants in the Yuma Regional Medical Center Silver Care Program, attendees of an Aging Well Resource Fair, the Senior Nutrition Center, the Cocopah

[‡] Excessive heat warnings are an adaptive measure of heat risk sensitive to daytime and overnight temperature and humidity relative to normal conditions for a locality at that time of year, the duration of heat, and whether temperatures are at levels that pose elevated risks of heat-related health effects. The criteria used to define heat warnings by the local weather forecasting office is continually refined to better reflect risk and protect health. Declared excessive heat warnings are used in this analysis to reflect existing conditions at the time of declaration, which informed heat response. <https://www.weather.gov/psr/Heat>

^{**} Data were prepared using data standards established by the Environmental Public Health Tracking Program for Heat Stress Hospitalizations. Visits were defined using ICD-9-CM codes for inpatient admissions during January 2010–September 2015 and ICD-10-CM codes for inpatient admissions during October 2015–December 2020. The diagnostic codes were used to search the 25 diagnoses fields and six external cause-of-injury fields contained within each discharge record. Visits where E900.1 (man-made source of heat) or W92 (exposure to excessive man-made source of heat) listed anywhere in the discharge record were excluded.

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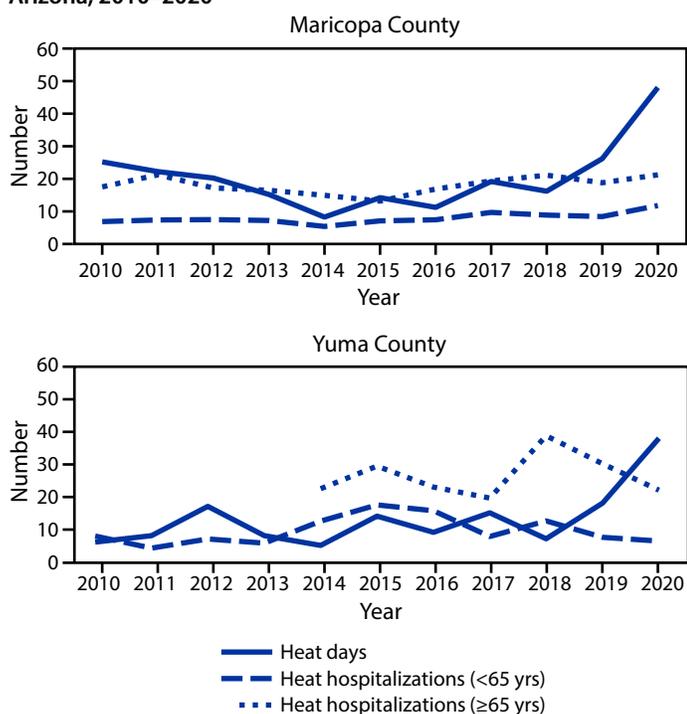
Indian Tribe, and the Yuma County website and Facebook page. The Institutional Review Board at Arizona State University reviewed, approved, and deemed this protocol nonresearch (evaluation). This activity was reviewed by CDC and was conducted consistent with applicable federal law and CDC policy.^{††}

Maricopa County cooling center data were collected from the Maricopa Association of Governments and include only cooling centers that were part of the Heat Relief Regional Network; cooling centers established as part of the COVID-19 response were not included. The presence of cooling centers in areas where persons were at higher risk for HRI was analyzed using the SVI, recalculated in R (version 4.1.2; R Foundation) at the census tract scale, and overlaid with cooling center locations in Maricopa and Yuma counties (6). Census tracts in the top 25% of SVI scores within each county were considered highly vulnerable. The total number of cooling centers in 2019 was compared with that in 2020.

During 2010–2020, the number of heat days increased by an average of 1.18 per year in Maricopa County and 1.71 per year in Yuma County (Figure). Persons aged ≥ 65 years in both counties were at higher risk for HRI-related hospitalizations than those aged < 65 years. In Maricopa and Yuma counties, the average rate ratios comparing hospitalizations among persons aged

^{††} 45 C.F.R. part 46, 21 C.F.R. part 56; 42 U.S.C. Sect. 241(d); 5 U.S.C. Sect. 552a; 44 U.S.C. Sect. 3501 et seq.

FIGURE. Number of heat days* and heat-related inpatient hospitalizations, by age group — Maricopa and Yuma counties, Arizona, 2010–2020



* Days with an excessive heat warning issued by the National Weather Service, Phoenix Office, for any part of Maricopa and Yuma counties.

≥ 65 years with those among persons aged < 65 years were 2.31 (range = 1.83–2.97) and 2.72 (range = 1.46–4.02), respectively. Adults aged < 65 years in Maricopa and Yuma counties experienced an average increase in the HRI-related hospitalization rate of 0.36 and 0.27 per 100,000 population, respectively, each year, compared with 0.26 and 0.76 for adults aged ≥ 65 years. During 2019–2020, HRI hospitalization rates among adults aged ≥ 65 years and < 65 years increased from 18.56 to 21.04 and from 8.15 to 11.52, respectively, in Maricopa County; in Yuma County, rates in these age groups decreased from 30.11 to 23.00 and from 7.50 to 6.32, respectively.

In surveys that included a total of 39 residents aged ≥ 65 years in Yuma County, 36% were male, and 69% were White persons. Overall, 26% of respondents felt their health was endangered on very hot days, and 15% always or sometimes felt too hot at home (Table). Overall, 44% of respondents reported experiencing heat-related medical symptoms during the last year. Respondents also indicated challenges ensuring reliable air conditioning at home, with 18% reporting that the cost of electricity always or sometimes prevented the use of air conditioning. In addition, devices not working, cost of repairs, and confusing technology were reported as limiting factors in air conditioning use. Overall, 54% of respondents indicated they knew what a cooling center was, and 36% knew of cooling center locations in their area. Additional limitations to cooling center use included transportation and inability to bring pets. Alternative options, such as libraries, restaurants, and friend or family homes, were listed as locations to seek cooling.

In both 2019 and 2020, approximately one half of cooling centers in Maricopa County (54.3% and 48.1%, respectively) were in an area with high social vulnerability. In Yuma County, 60.0% and 83.3% of cooling centers were in high social vulnerability areas in 2019 and 2020, respectively.

Discussion

Increasing HRIs in Arizona are consistent with higher temperatures observed during 2010–2020, although other social factors have likely influenced this trend. Older adults in Yuma County have reported heat-related medical symptoms and feeling that their health was in danger during hot weather. HRIs disproportionately affect populations at higher risk for heat impact, including those experiencing homelessness, nonnative English speakers or those with limited communication, those with limited financial resources, outdoor workers, communities of color, those with mental health disability or chronic medical conditions, those without access to air conditioning, older adults, and children; several of these groups were included in the CDC SVI (7).

Rising heat exposure and HRIs observed in Arizona are not limited to the Southwest region. Extreme heat is a growing problem nationally because heat waves have increased

TABLE. Experiences related to severe heat and characteristics related to cooling center use among persons aged ≥65 years (N = 39) — Yuma County, Arizona, 2018–2019

Experiences related to severe heat	No. (%)
Medical symptoms related to heat*	
Yes	17 (44)
No	20 (51)
Not answered	2 (5)
Frequency of feeling too hot in home[†]	
Always or sometimes	6 (15)
Rarely or never	29 (74)
Not answered	4 (10)
Feel health in danger during very hot days[‡]	
Yes	10 (26)
No	25 (64)
Not answered	4 (10)
Characteristics related to cooling center use	
Know what a cooling center is[¶]	
Yes	21 (54)
No	18 (46)
Know where a cooling center is^{**}	
Yes	14 (36)
No	25 (64)
Ever visited a cooling center^{††}	
Yes	3 (8)
No	19 (49)
Not answered	17 (44)
Electricity costs prevent keeping home cool^{§§}	
Always or sometimes	7 (18)
Rarely or never	28 (72)
Not answered	4 (10)

* Assessed using the question, "During the past year, have you had medical symptoms related to heat? For example, muscle cramps, dizziness, tiredness, weakness, throbbing headache, nausea or vomiting, fainting, or paleness?"

† Assessed using the question, "In the summer, how frequently do you feel too hot inside your home?"

‡ Assessed using the question, "On very hot days do you ever feel your health is in danger?"

¶ Assessed using the question, "Do you know what a cooling center is?"

** Assessed using the question, "Do you know where cooling centers are located in your area?"

†† Assessed using the question, "Have you ever visited a cooling center in Yuma County?"

§§ Assessed using the question, "How often does the cost of electricity prevent you from keeping your home cool?"

in intensity, duration, and frequency in recent decades (8). Higher urban temperatures might enhance the risk for HRIs among urban residents because of urban heat islands, in which concentrations of pavement, buildings, and other surfaces that absorb and retain heat elevate ambient temperatures in cities by up to 22°F (12.2°C) (9). The disproportionate impact of heat on older adults has been observed previously, including in the 2021 Pacific Northwest heat wave (10).

Cooling centers might be a useful strategy to reduce heat exposure when access to air conditioning is limited. In a warming climate, cities and towns can use cooling centers to provide relief from extreme heat as part of a comprehensive heat response strategy. However, several barriers inhibit cooling center use, including the inability to bring pets and limited

Summary

What is already known about this topic?

Exposure to excessive heat is an increasing threat in a warming climate. Some groups, including older adults, are disproportionately affected by heat exposure.

What is added by this report?

Heat exposure and heat-related illness (HRI) increased in Maricopa and Yuma counties, Arizona, during 2010–2020. Heat-related hospitalizations were higher among adults aged ≥65 years than those aged <65 years. Barriers to cooling center access among older adults include awareness of location and transportation.

What are the implications for public health practice?

States and communities can implement adaptation and evaluation strategies to mitigate and assess heat risk, such as the use of cooling centers to protect communities disproportionately affected by HRI during periods of high temperatures.

access by public transportation. To improve access, public health departments can enhance communication campaigns to increase awareness of benefits and locations of cooling centers and open cooling centers in locations of high social vulnerability. Cooling center managers can increase hours of operation and provide multilingual communications materials. Local jurisdictions can also extend cooling center access in locations such as libraries or enhance public-private partnerships with businesses to expand access during extreme heat events. More research is needed to determine the optimal amount of time spent in a cooling center relative to home temperature to achieve health-related benefits. §§, ¶¶

The findings in this report are subject to at least four limitations. First, analysis by more discrete age and demographic groups was not possible in Yuma County because of data suppression limitations (i.e., health privacy concerns and any group with fewer than six hospitalizations per year). Second, a small convenience sample was used for the survey, which limits generalizability. Third, the number of cooling centers overlaid with SVI data was taken as a snapshot in time from a single data source that did not include centers opened as part of the pandemic response. Finally, the survey only assessed cooling centers, which are one of many factors that can help reduce HRIs. For example, the Arizona Corporation Commission implemented a temporary ban on power shutoffs to help maintain air conditioning access during the summers of 2019 and 2020.

§§ Cooling center best practices including COVID-19 precautions. <https://www.cdc.gov/climateandhealth/docs/UseOfCoolingCenters.pdf>

¶¶ COVID-19 and cooling centers. <https://www.cdc.gov/coronavirus/2019-ncov/php/cooling-center.html>

Collaboration among diverse community sectors and health profession education programs is important to better prepare for rising heat exposure and HRIs. A comprehensive system of heat mitigation planning and response through both behavioral and infrastructural interventions can improve heat resilience and protect communities disproportionately affected by HRI during periods of high temperatures.

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