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It's Hot out There: Extreme Temperatures and Children's Emergency Department Visits

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Most research on the health impacts of heat has focused on the elderly; there are few studies on children. Yet children are thought to be especially vulnerable to heat because of their lower thermoregulatory capacity and their dependence on adults to protect them from heat and other environmental threats.[1,2,3] A new study in *Environmental Health Perspectives* addressed the association between extreme heat during the U.S. warm season (May to September) and child visits to an emergency department (ED).[4]

Previous research in adults has found that high ambient temperatures are associated with illnesses ranging from heat stroke and heart attack to renal failure, urinary tract infection, and other conditions.[5] Extreme heat is also associated with higher mortality rates, including higher rates of suicide.[6]

The authors of the new study analyzed 3.8 million ED visits by children and adolescents up to 18 years of age over a 3-year period. They used data from 47 children's hospitals in the United States that participate in the Pediatric Health Information System of the Children's Hospital Association (CHA). The researchers estimated daily ambient temperatures for each hospital, defining heat as "extreme" if it reached or exceeded the 95th percentile of each hospital's warm-season daily high temperature.

Their analysis showed an increased risk of children's ED visits for any reason in association with extreme heat, compared with days of moderate heat. Associations were strongest among children of color and those without private health insurance. Extreme heat was most strongly associated with ED visits for heat-related illnesses, as well as with visits for other illnesses, including bacterial enteritis and ear infections. Visits for conditions such as asthma and other respiratory diseases, and for mental, behavioral, and neurodevelopmental disorders, were not strongly associated with heat.

Nearly 12% of any-cause ED visits and 31% of heat-related visits occurred at temperatures above the hospital-specific minimum morbidity temperature—the temperature associated with the fewest heat-related visits. "Our definition of heat-related diagnoses included not only illnesses such as heat stroke and heat exhaustion, but also dehydration and fluid and electrolyte disorders," Bernstein explains. "The former diagnoses would be almost entirely explained by temperatures over minimum morbidity temperature, while the others will have substantial shares below it."

Increased risk of heat-related ED visits was not limited to the hottest days; nearly all these visits occurred at temperatures below

A new study showed children and teens were more likely to visit the ED for any reason on extremely hot days. But even moderately hot weather was associated with more visits. "We can do more to keep children safe from extreme heat," says study coauthor Aaron Bernstein. Image: © Ken Hurst/Shutterstock.com.

the 95th percentile. In other words, heat did not have to be "extreme" to be associated with ED visits.

What surprised lead author Aaron Bernstein, interim director of the Center for Climate, Health, and the Global Environment at the Harvard T.H. Chan School of Public Health, was that the increased risk of ED visits for any reason during extreme heat was greater than that observed for adults in other research. For example, one recent study[7] reported a 7.8% increase in all-cause ED visits for adults 18 years of age and older, compared with a 17% increase for children at similar heat exposures in the current study.

"We now know more about the clinical conditions most associated with emergency care needs for children in hotter weather," says Rebecca Philipsborn, an assistant professor of pediatrics at Emory University, who was not involved in the study. "This study helps to bolster the evidence base around the implications of heat in a warming climate for children and their health emergency care needs."

"The findings confirm that awareness of and prevention for acute heat-related illness—heat stroke and heat exhaustion—is of primary importance in children, even at moderate temperatures that many parents and practitioners may not think are dangerous," says Jeremy Hess, a professor of emergency medicine at the University of Washington. "The association with bacterial enteritis is interesting and consistent across studies, but the underlying disease pathways are not clear from this work."

Hess, who also was not involved in the study, says he would have liked to see the study explore more about specific outcomes to determine whether there was an association that might be obscured in the larger groupings of diagnoses. However, he says the methods overall are quite strong, setting the bar for how future studies should be conducted. "Unfortunately, these methods require a relatively high level of expertise and may be out of reach for analysts in some practice settings," he adds. "Nevertheless, it's important to know where the field should aim methodologically."

"As a pediatrician interested in climate change, I am highly motivated to augment the embarrassingly small number of studies we have that address climate risks to children," says Bernstein. "The lack of research stems in part from a lack of large data sets to analyze." He says it is fortunate that the CHA has collected data on ED visits at major children's hospitals around the country for years and "were eager to have their data used to investigate climate risks in children."

Bernstein and colleagues plan to pursue other questions related to climate and children's health with the data from the CHA. They also want to develop resources for health care providers to help prevent harm caused by heat. "We can do more to keep children safe from extreme heat," he says, "which is ever more common due to climate change."

Wendee Nicole is an award-winning science writer in Houston. She has written for *Discover*, *Defenders of Wildlife*, and other publications.

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