BRIEF

Heat-Related Illness

A Window into Recent Trends

A FAIR Health Brief, December 13, 2022

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Summary

Average summer temperatures in the United States have been rising. The Centers for Disease Control and Prevention has identified projected increases in extreme summer heat as one source of adverse health impacts from climate change. However, systematic, national data on trends in heat-related illnesses in the United States have been lacking. With this report, FAIR Health seeks to help address this research gap. Drawing on its repository of more than 39 billion private healthcare claim records—the nation's largest such repository—FAIR Health analyzed recent trends and patterns in heat-related illnesses in the United States. Three types of heat-related illness—in order of increasing severity, heat stress, heat exhaustion and heatstroke—were examined in the period from May through September for the years 2016-2021. Changes in percent of patients diagnosed, as well as their age and gender, were studied for each type of illness. Among the key findings:

- The percentage of patients who were diagnosed with heat stress, heat exhaustion or heatstroke was higher in each month in 2021 than in the corresponding month of 2016.
- Of the three heat-related illnesses studied, heat exhaustion had the greatest increase from one month—i.e., June—of 2016 to the corresponding month of 2021. In that month, the percentage of patients diagnosed with heat exhaustion rose 52.5 percent, from 0.83 percent of patients receiving medical services in 2016 to 1.26 percent in 2021. By comparison, the greatest increase for heatstroke was 40.1 percent from September 2016 to September 2021. The greatest increase for heat stress was 37.8 percent from May 2016 to May 2021.
- The percentage of patients with heat stress, heat exhaustion or heatstroke diagnoses increased with age, with the greatest percentage found in the age group 65 years and older. Of patients who received medical services nationally in the 65-and-older population, 2.61 percent had a diagnosis of heat exhaustion, 1.93 percent had a diagnosis of heat stress and 0.70 percent had a diagnosis of heatstroke.
- More males than females were diagnosed with the three heat-related illnesses studied. Though the distribution was close for heat stress (males 52 percent, females 48 percent), there was greater gender disparity for heat exhaustion and heatstroke. For each of these diagnoses, males constituted 64 percent and females constituted 36 percent.
- Age was a factor in whether males or females were more likely to be diagnosed with heat stress. In individuals 36 years and older, males were more likely than females to be diagnosed; in individuals 35 years and younger, females were more likely than males to be diagnosed with heat stress. For heat exhaustion and heatstroke, males were more likely than females to be diagnosed in every age group.
- For all three heat-related illnesses studied, the largest disparity between males and females in percentage of diagnoses was in the age group 55 to 64.

Background

Average annual temperatures have been growing globally for more than a century.[1] In the United States, one recent sign of this climate change has been hotter summers. According to a *Washington Post* analysis of data from the National Oceanic and Atmospheric Administration (NOAA), the average summer temperature increase in the United States from 2017 to 2021 was 1.7°F warmer than from 1971 to 2000,

[1] US Global Change Research Program (USGCRP), *Impacts, Risks, and Adaptation in the United States: Fourth National Climate Assessment,* Volume II, Chapter 2, "Our Changing Climate" (Washington, DC: USGCRP, 2018), https://www.doi.org/10.7930/NCA4.2018.

with the West exhibiting an increase of 2.7°F.[2] The Centers for Disease Control and Prevention (CDC) has identified projected increases in extreme summer heat as one source of adverse health impacts from climate change.[3]

Some researchers have found evidence that adverse health impacts related to increases in global heat are already occurring. Globally, from 2000 to 2018, there was a 53.7 percent increase in heat-related mortality in people older than 65 years.[4] During a heat wave in 2021 in the northwestern United States, 1,038 heat-related emergency department visits occurred on a single day, compared with 9 such visits on the same date in 2019.[5] However, systematic, national data on trends in heat-related illnesses in the United States have been lacking. With this report, FAIR Health seeks to help address this research gap.

Drawing on its repository of more than 39 billion private healthcare claim records—the nation's largest such repository—FAIR Health analyzed recent trends and patterns in heat-related illnesses in the United States. Three types of heat-related illness—in order of increasing severity, heat stress, heat exhaustion and heatstroke—were examined in the period from May through September for the years 2016-2021. Changes in percent of patients diagnosed, as well as their age and gender, were studied for each type of illness.

Methodology

Using longitudinal data from its private healthcare claims repository, FAIR Health studied patients with ICD-10 diagnoses indicative of three heat-related illnesses in the period 2016 to 2021:

- **Heat stress.** This includes health factors related to heat exposure such as heat syncope (fainting), heat cramps, heat fatigue and heat edema (swelling). Sample ICD-10 codes include T67.1XXA, heat syncope, initial encounter; T67.2XXA, heat cramp, initial encounter; and T67.7XXA, heat edema, initial encounter.
- **Heat exhaustion.** The symptoms of this condition include heavy sweating and rapid pulse. It is typically caused by physical exertion in an environment with high temperatures combined with high humidity. Sample ICD-10 codes include T67.3XXA, heat exhaustion, anhydrotic, initial encounter; and T67.4XXA, heat exhaustion due to salt depletion, initial encounter.
- **Heatstroke.** This is the most serious of the heat-related illnesses. In this life-threatening condition, the body can no longer control its own temperature. Body temperature increases rapidly, sweating may cease and the body is unable to cool itself down. Sample ICD-10 codes include T67.02XA, exertional heatstroke, initial encounter; and T67.0XXA, heatstroke and sunstroke, initial encounter.

FAIR Health evaluated information for these patients during the months of May, June, July, August and September to account for the months of the highest temperatures and to acquire a more robust analysis of the conditions.

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[2] Anna Phillips et al., "Summer in America Is Becoming Hotter, Longer and More Dangerous," *Washington Post*, July 2, 2022, https://www.washingtonpost.com/climate-environment/2022/07/02/summer-2022-climate-change-heat/.
[3] "Temperature Extremes," Centers for Disease Control and Prevention (CDC), page last reviewed September 6, 2022, https://www.cdc.gov/climateandhealth/effects/temperature_extremes.htm.
[4] Nick Watts et al., "The 2020 Report of The *Lancet* Countdown on Health and Climate Change: Responding to Converging Crises," *The Lancet* 397, no. 10269 (January 9, 2021): 129-70, https://doi.org/10.1016/S0140-6736(20)32290-X.
[5] Paul J. Schramm et al., "Heat-Related Emergency Department Visits during the Northwestern Heat Wave—United States, June 2021," *Morbidity and Mortality Weekly Report* 70, no. 29 (July 23, 2021): 1020-21, https://doi.org/10.15585/mmwr.mm7029e1.

Using this patient population during the specified time period, FAIR Health analyzed the study population by such variables as age and gender, and compared the prevalence of each of the conditions to the greater population of individuals who had medical claims within those time periods and/or age groups.

When determining distribution by age group, the calculation used was: number of unique patients in the age group who were diagnosed with the condition divided by the number of unique patients with at least one inpatient or outpatient medical claim in the database in that age group.

Limitations

The data used in this report comprise claims data for privately insured patients who are covered by insurers and third-party administrators who voluntarily participate in FAIR Health's data contribution program. Medicare Advantage (Medicare Part C) enrollees from contributing insurers are included, but not participants in Medicare Parts A, B and D.[6] In addition, data from Medicaid, CHIP and other state and local government insurance programs are not included, nor are data collected regarding uninsured patients.

This is an observational report based on the data FAIR Health receives from private payors regarding care rendered to covered patients.

This report was not subject to peer review.

[6] FAIR Health also receives the entire collection of claims for traditional Medicare Parts A, B and D under the Centers for Medicare & Medicaid Services Qualified Entity Program, but those data are not a source for this report.

Results

Heat Stress

In every month from May to September, among all patients nationally who received medical services, the percentage who were diagnosed with heat stress increased when comparing one month in 2016 to the same month in 2021 (figure 1, table 1). The greatest increase, 37.8 percent, was from May 2016 to May 2021; the smallest, 6.7 percent, from August 2016 to August 2021.

In most months, the year with the greatest percentage of patients diagnosed with heat stress was the most recent year studied, 2021. The exceptions were August and September. In August, the years with the greatest percentage of heat stress patients were 2018 and 2020, each with 0.56 percent of patients. In September, the peak year was 2018, with 0.58 percent of patients diagnosed with heat stress.

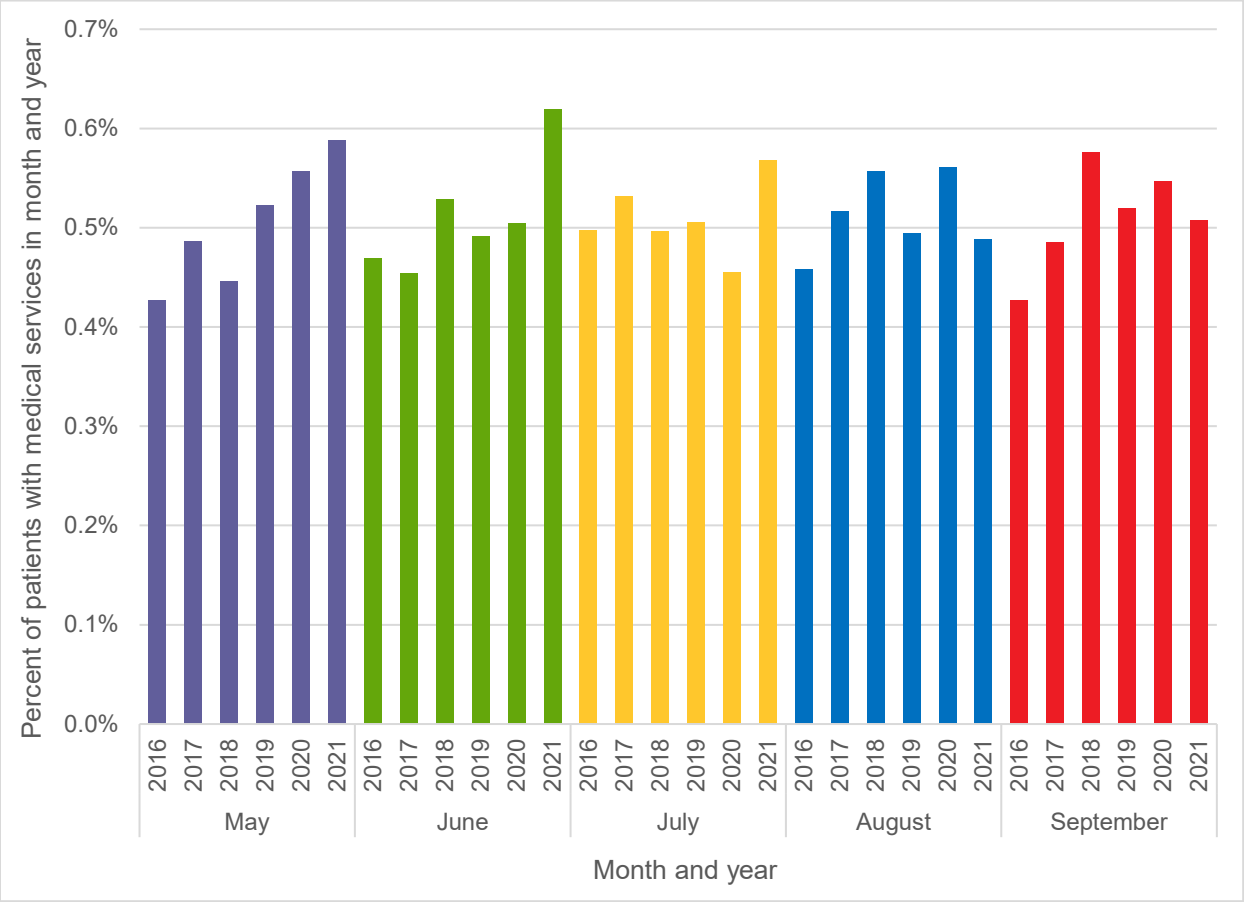

Figure 1. Patients diagnosed with heat stress as a percentage of patients who received medical services nationally, May-September 2016-2021

Table 1. Increase in percent of patients diagnosed with heat stress, 2016-2021

Month	May	June	July	August	September
Percent Increase	37.8%	32.1%	14.2%	6.7%	18.7%

In the study period of May through September for the years 2016-2021, individuals aged 65 years and older were more than twice as likely to be diagnosed with heat stress as the next most likely age group, those aged 55 to 64 years (figure 2). Of patients who received medical services nationally in the 65-and-older population, 1.93 percent had a diagnosis of heat stress, compared to 0.85 percent in the 55-64 age group. Each age group from 19 to 35 and up had a higher percentage of heat stress diagnoses than the next youngest age group, but only between the age groups 36-54 and 55-64, and between 55-64 and 65 and over, were the differences statistically significant. Other researchers have found that adults aged 65 years and older are at the highest risk for heat-related illness, though they have also identified children aged younger than 5[7] or 15[8] at elevated risk.

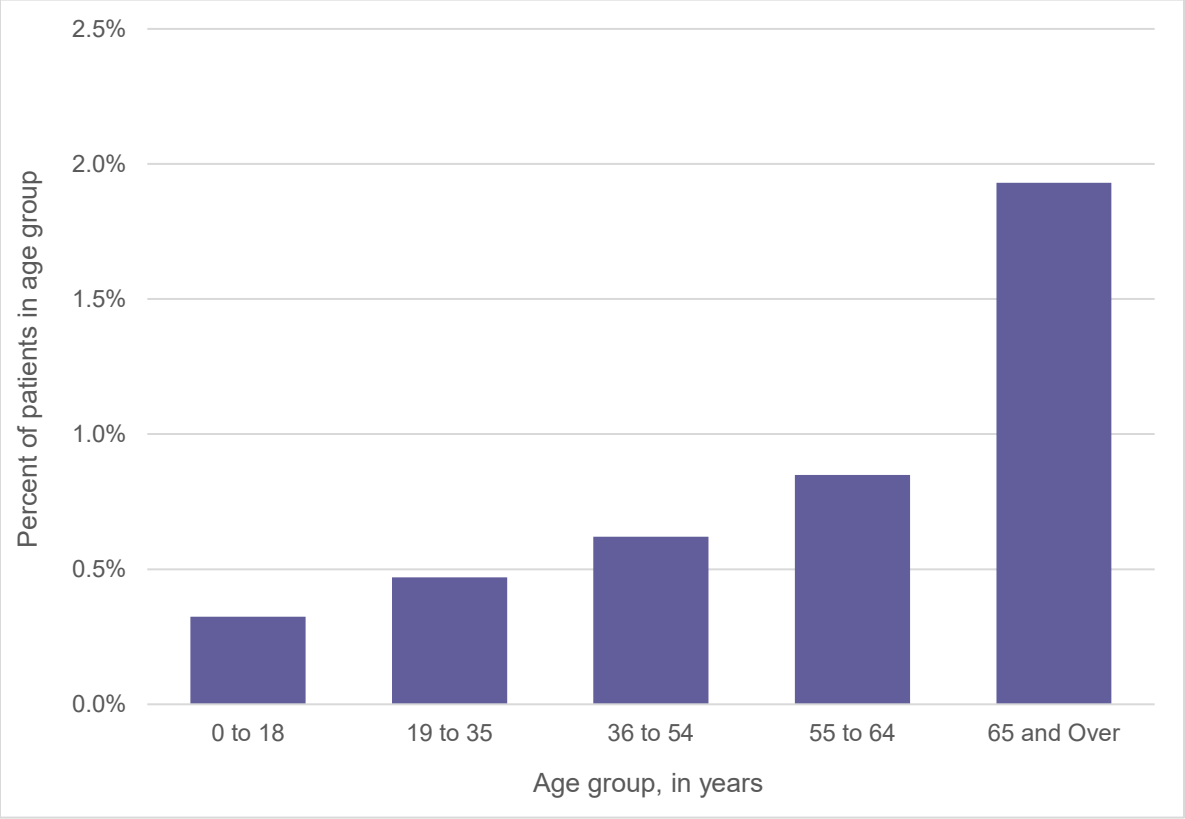

Figure 2. Patients diagnosed with heat stress as a percentage of patients who received medical services nationally by age group, May-September 2016-2021

[7] *Picture of America Report: Heat-Related Illness*, CDC, accessed November 23, 2022, https://www.cdc.gov/pictureofamerica/pdfs/picture_of_america_heat-related_illness.pdf.
[8] Robert Gauer and Bryce K. Meyers, "Heat-Related Illnesses," *American Family Physician* 99, no. 8 (April 15, 2019): 482-89, https://www.aafp.org/pubs/afp/issues/2019/0415/p482.html.

More males (52 percent) were diagnosed with heat stress than females (48 percent), though the distribution was relatively similar (figure 3). The association of heat-related illness with male gender has been noted by other researchers.[9,10,11] Possible reasons for that association may include occupational factors, such as the greater likelihood of men working in outdoor jobs such as construction or agriculture.[12]

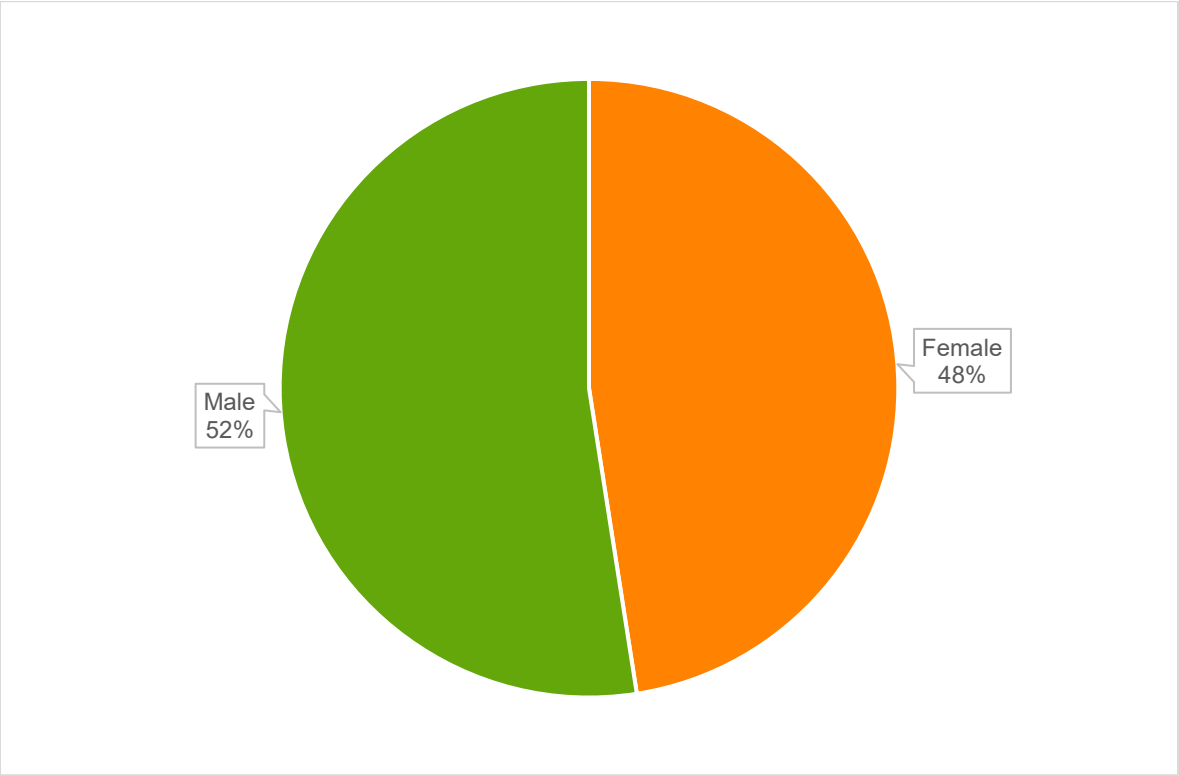

Figure 3. Patients diagnosed with heat stress by gender nationally, May-September 2016-2021

[9] Robert M. Gifford et al., "Risk of Heat Illness in Men and Women: A Systematic Review and Meta-analysis," *Environmental Research* 171 (April 2019): 24-35, https://doi.org/10.1016/j.envres.2018.10.020.
[10] *Picture of America Report: Heat-Related Illness*.
[11] Luke N. Belval et al., "Age- and Sex-Based Differences in Exertional Heat Stroke Incidence in a 7-Mile Road Race," *Journal of Athletic Training* 55, no. 12 (November 11, 2020): 1224-29, https://doi.org/10.4085/1062-6050-539-19.
[12] "Climate Change Indicators: Heat-Related Illnesses," United States Environmental Protection Agency, updated August 2016, https://www.epa.gov/climate-indicators/heat-related-illnesses.

Age was a factor in whether males or females were more likely to be diagnosed with heat stress (figure 4). In individuals aged 36 years and older, males were more likely than females to be diagnosed with heat stress; in individuals 35 and younger, females were more likely to be diagnosed with heat stress. The greatest gender disparity was in the age group 55 to 64, in which males constituted 56 percent and females constituted 44 percent of patients diagnosed with heat stress.

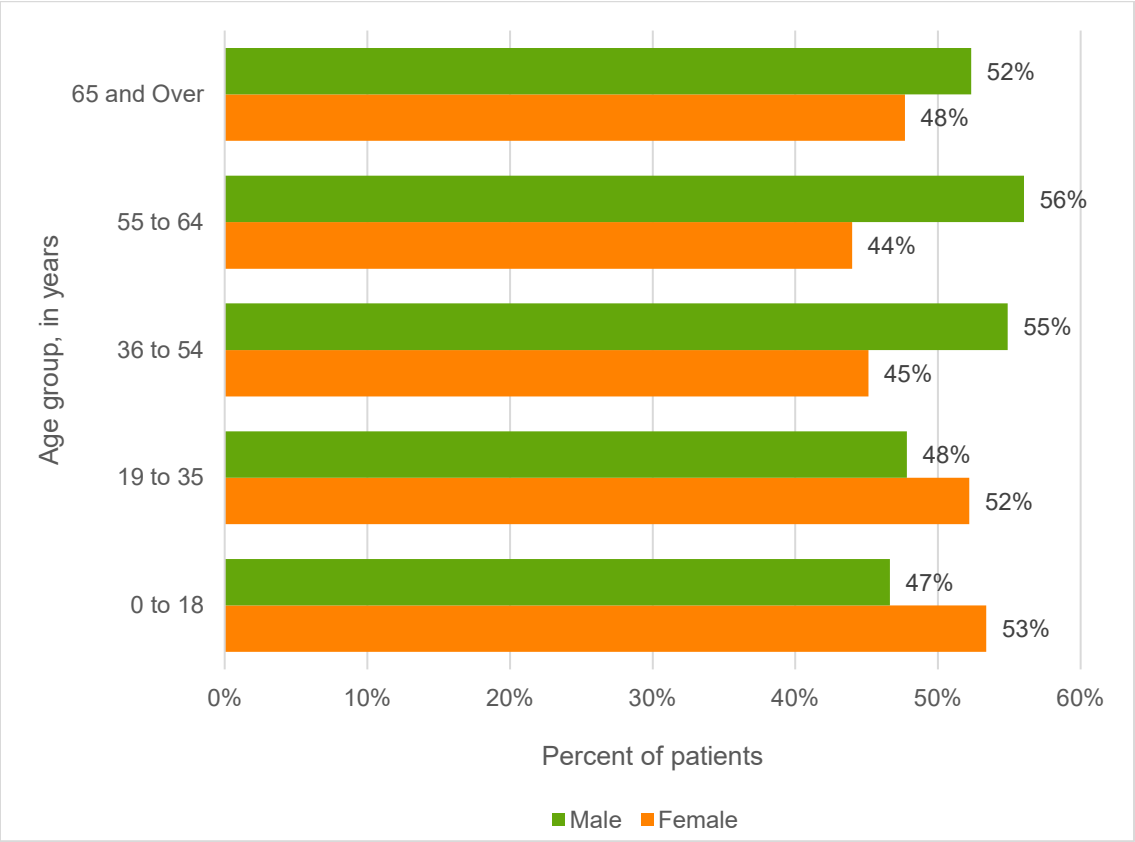

Figure 4. Patients diagnosed with heat stress by age group and gender nationally, May-September 2016-2021

Heat Exhaustion

In every month from May to September, among all patients nationally who received medical services, the percentage who were diagnosed with heat exhaustion increased when comparing a month in 2016 to the same month in 2021 (figure 5, table 2). The increases were greater than for heat stress in the corresponding months. The greatest increase for heat exhaustion, 52.5 percent, was from June 2016 to June 2021; the smallest increase for heat exhaustion, 25.9 percent, was between September 2016 and September 2021.

In June, the year with the greatest percentage of patients diagnosed with heat exhaustion was 2021. In all other months studied, 2020 was the peak year for heat exhaustion. July 2020 was the month and year with the greatest percentage of patients diagnosed with heat exhaustion, 1.30 percent. In May, there was a 60.1 percent increase in the percentage of heat exhaustion patients from 0.69 percent in 2016 to 1.11 percent in 2020, then a decrease of 6.0 percent to 1.04 percent in 2021.

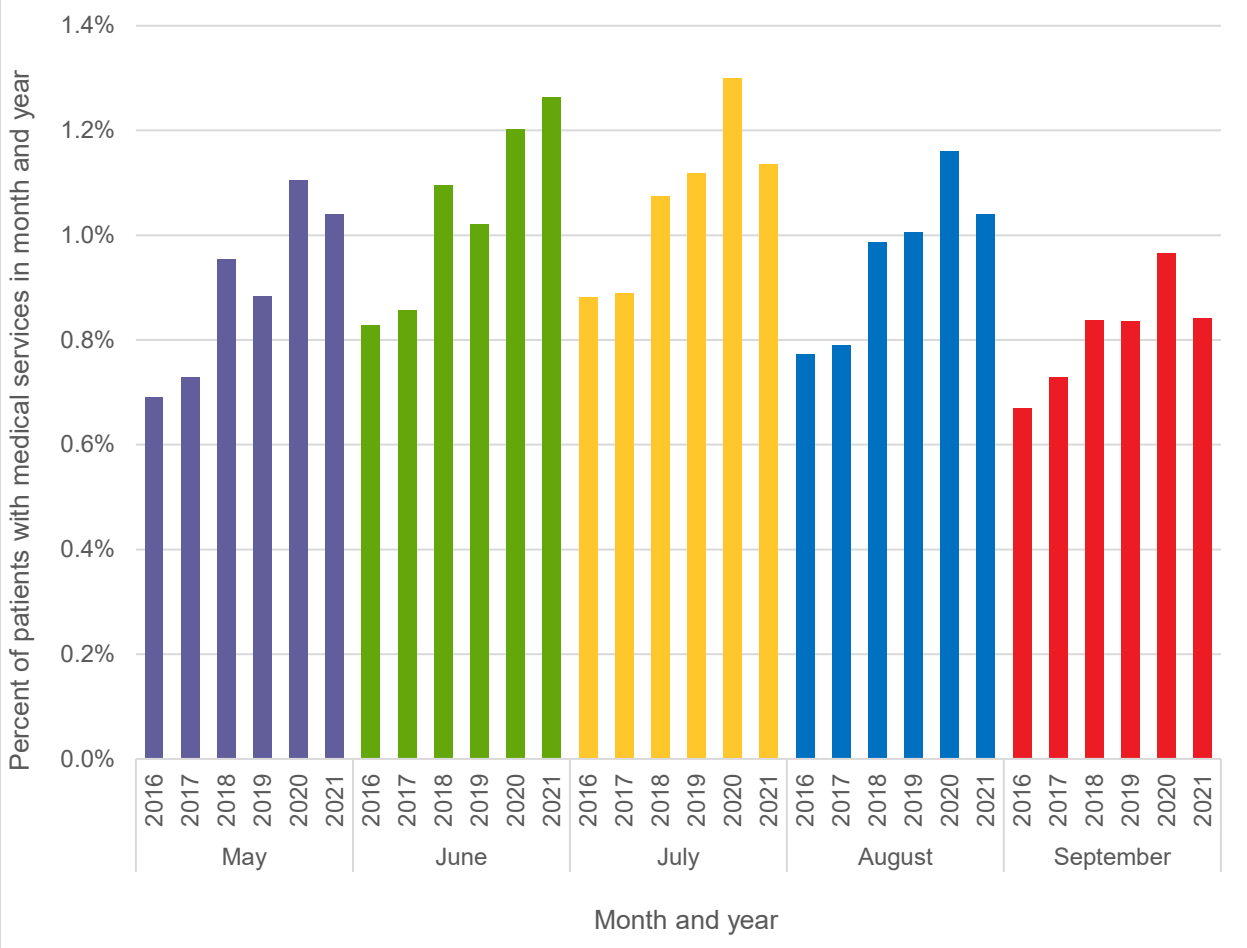

Figure 5. Patients diagnosed with heat exhaustion as a percentage of patients who received medical services nationally, May-September 2016-2021

Table 2. Increase in percent of patients diagnosed with heat exhaustion, 2016-2021

Month	May	June	July	August	September
Percent Increase	50.5%	52.5%	29.0%	34.6%	25.9%

As in the case of heat stress, the percentage of patients with heat exhaustion diagnoses increased with age, with the greatest percentage found in the group aged 65 years and older (figure 6). Heat exhaustion affected 2.61 percent of patients who received medical services nationally in the 65-and-older population, compared to 1.71 percent in the 55-64 age group. The smallest percentage of patients diagnosed with heat exhaustion was in the 0-to-18 age group, 0.57 percent.

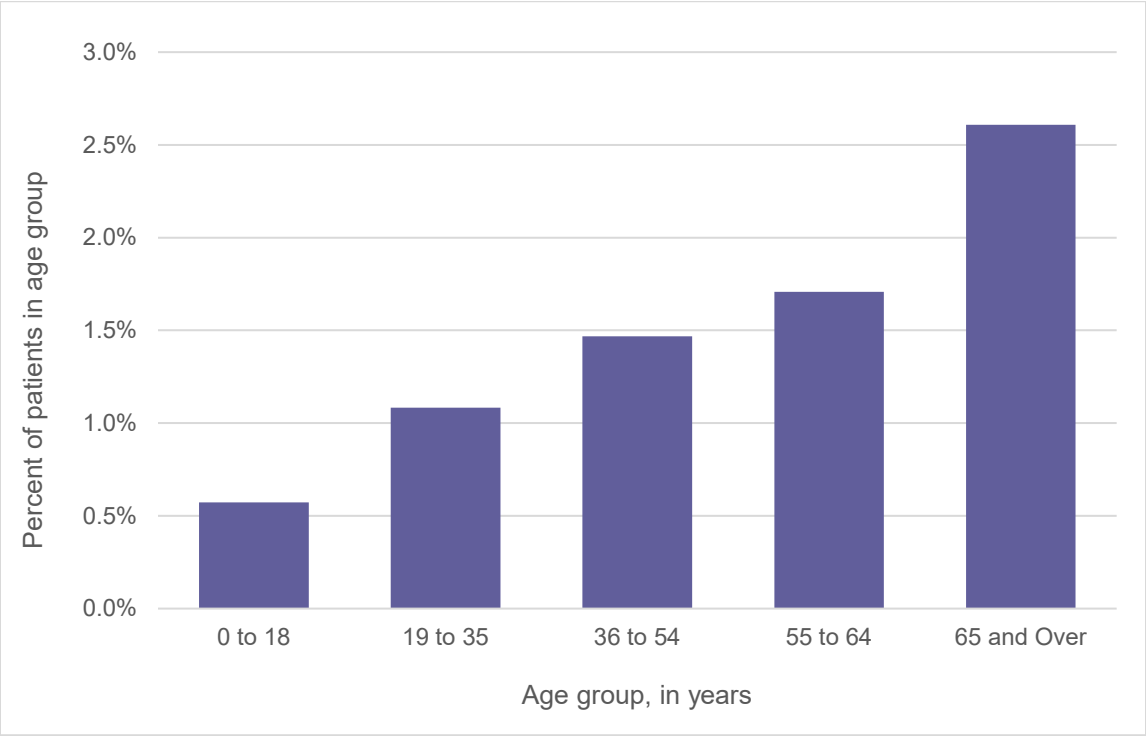

Figure 6. Patients diagnosed with heat exhaustion as a percentage of patients who received medical services nationally by age group, May-September 2016-2021

As in the case of heat stress, more males were diagnosed with heat exhaustion than females (figure 7). But while the share of each gender was close to equal for heat stress, males accounted for 64 percent of the diagnoses for heat exhaustion, and females only 36 percent. This is approximately the opposite of the gender distribution for most other conditions seen in FAIR Health data (see, for example, FAIR Health's FH® Healthcare Indicators and FH® Medical Price Index),[13] and of the findings of other researchers that women are more likely than men to visit physicians[14] and make use of healthcare services generally.[15]

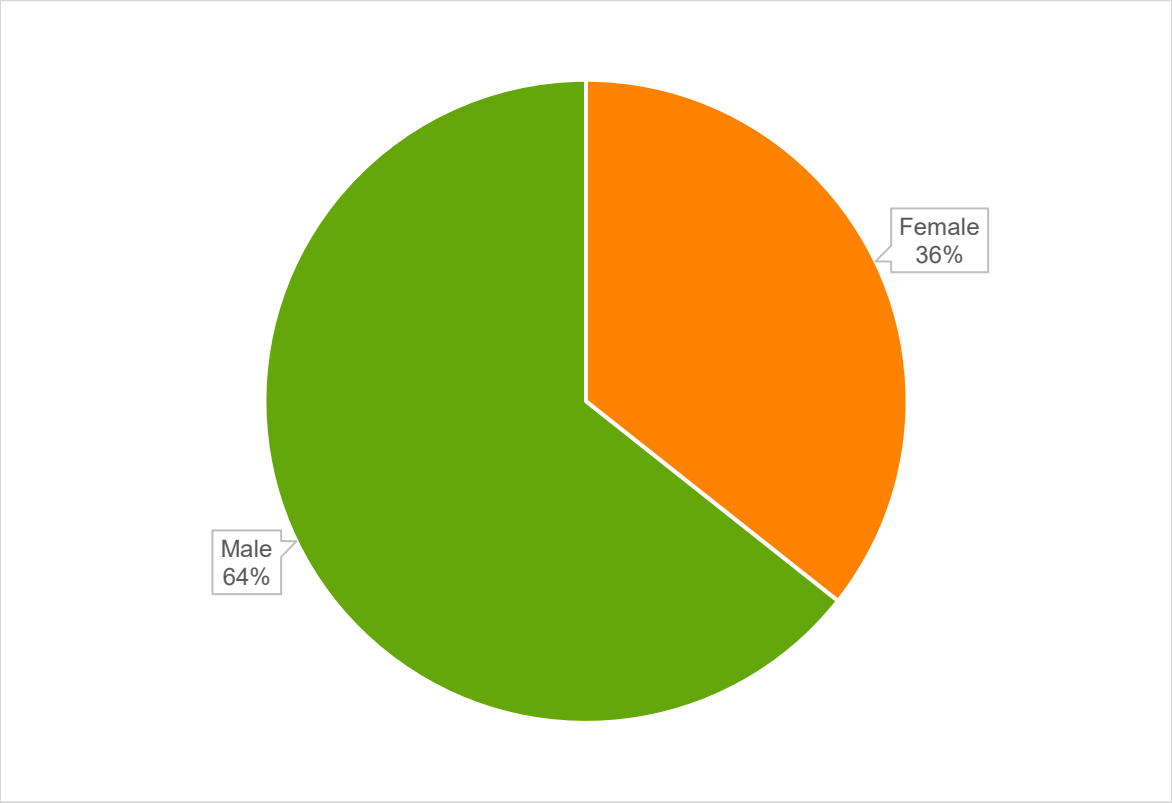

Figure 7. Patients diagnosed with heat exhaustion by gender nationally, May-September 2016-2021

[13] FAIR Health, *FH® Healthcare Indicators and FH® Medical Price Index 2022: An Annual View of Place of Service Trends and Medical Pricing*, A FAIR Health White Paper, March 31, 2022, https://s3.amazonaws.com/media2.fairhealth.org/whitepaper/asset/FH%20Healthcare%20Indicators%20and%20FH%20Medical%20Price%20Index%202022--A%20FAIR%20Health%20White%20Paper.pdf.

[14] Jill J. Ashman, Esther Hing and Anjali Talwalkar, *Variation in Physician Office Visit Rates by Patient Characteristics and State, 2012*, NCHS Data Brief, no. 212 (Hyattsville, MD: National Center for Health Statistics, 2015), https://www.cdc.gov/nchs/data/databriefs/db212.pdf.

[15] Klea D. Bertakis et al., "Gender Differences in the Utilization of Health Care Services," *Journal of Family Practice* 49, no. 2 (February 2000):147-52, https://www.ncbi.nlm.nih.gov/pubmed/10718692.

In every age group, males were diagnosed with heat exhaustion more than females (figure 8). The greatest percentage of females with a heat exhaustion diagnosis was in the age group 0 to 18 years (46 percent). The greatest percentage of males with a heat exhaustion diagnosis was in the age group 55 to 64 years (67 percent).

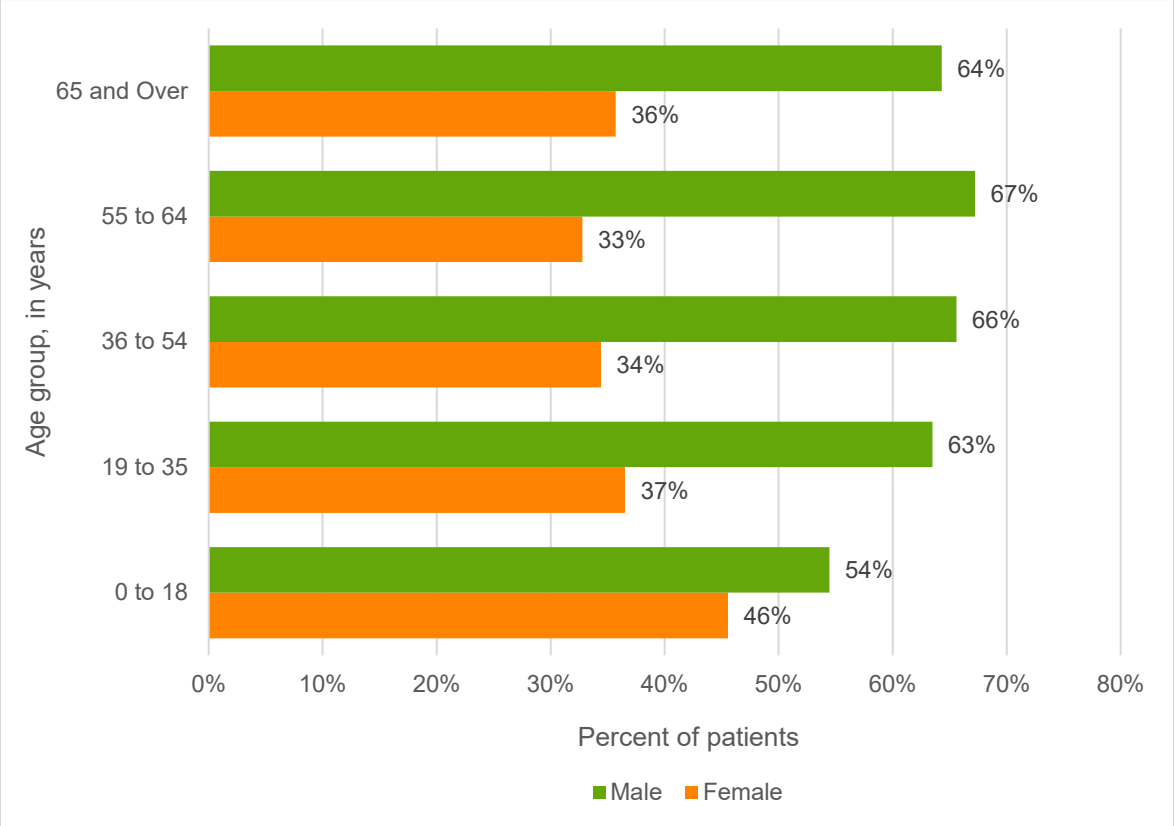

Figure 8. Patients diagnosed with heat exhaustion by age group and gender nationally, May-September 2016-2021

Heatstroke

In every month from May to September, among all patients nationally who received medical services, the percentage who were diagnosed with heatstroke increased when comparing one month in 2016 to the same month in 2021 (figure 9, table 3). The greatest increase, 40.1 percent, was observed between September 2016 and September 2021; the smallest increase, 12.0 percent, occurred from August 2016 to August 2021.

The peak years for heatstroke varied from month to month. In May, the years with the greatest percentage of patients diagnosed with heatstroke were 2020 and 2021, each with 0.19 percent. In June, the peak years were 2018 and 2021, each with 0.19 percent. In July, the peak year was 2021, at 0.20 percent. In August and September, the peak year was 2018, when the percentage of patients diagnosed with heatstroke reached 0.22 percent each month.

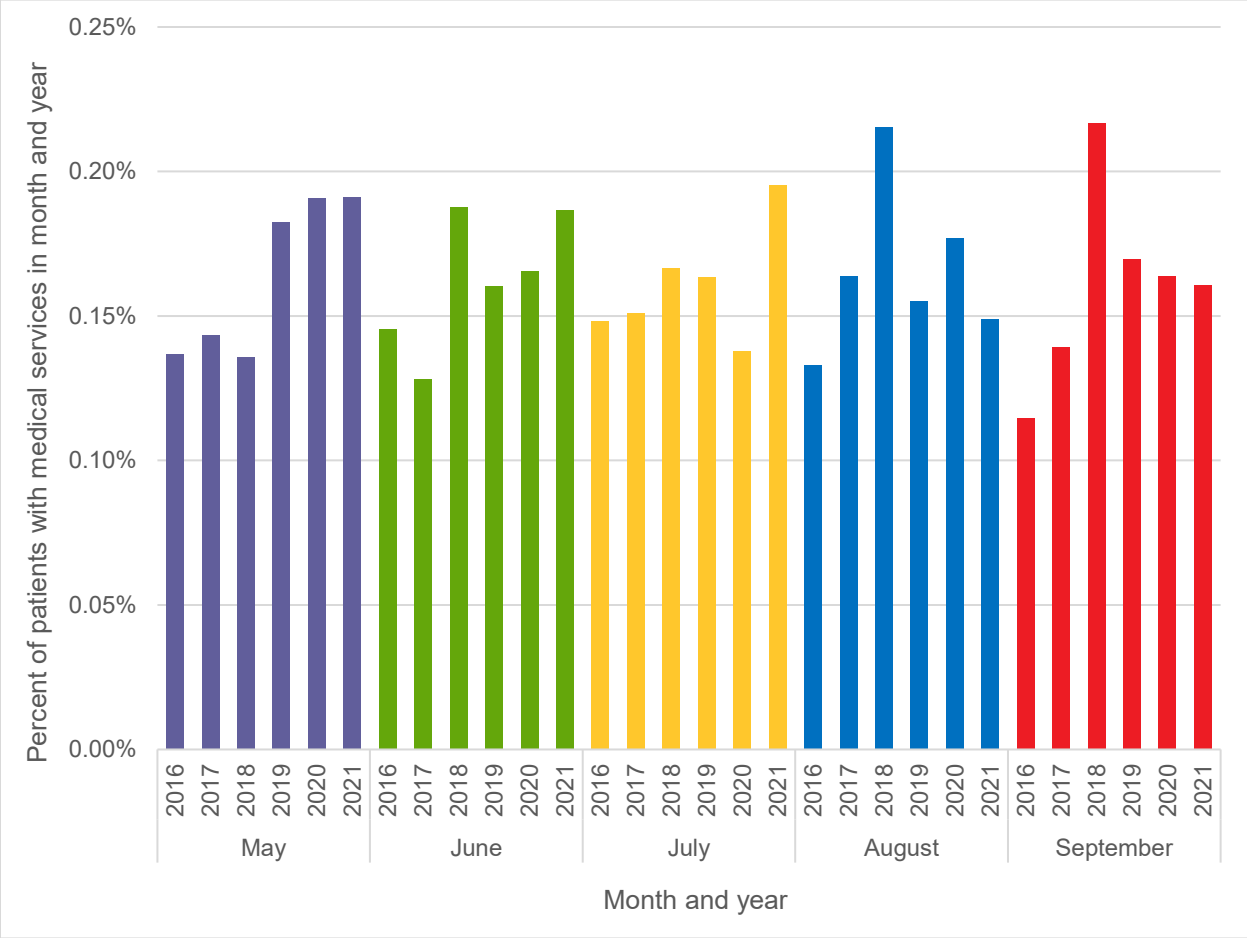

Figure 9. Patients diagnosed with heatstroke as a percentage of patients who received medical services nationally, May-September 2016-2021

Table 3. Increase in percent of patients diagnosed with heatstroke, 2016-2021

Month	May	June	July	August	September
Percent Increase	39.9%	28.2%	31.6%	12.0%	40.1%

As with heat stress and heat exhaustion, the percentage of patients with heatstroke diagnoses increased with age, with the greatest percentage in the age group 65 years and older (figure 10). Heatstroke was diagnosed in 0.70 percent of patients who received medical services nationally in the 65-and-older population, 2.54 times as much as the percentage diagnosed in the 55-64 age group (0.28 percent). The smallest percentage of patients diagnosed with heatstroke was in the 0-18 age group, 0.06 percent.

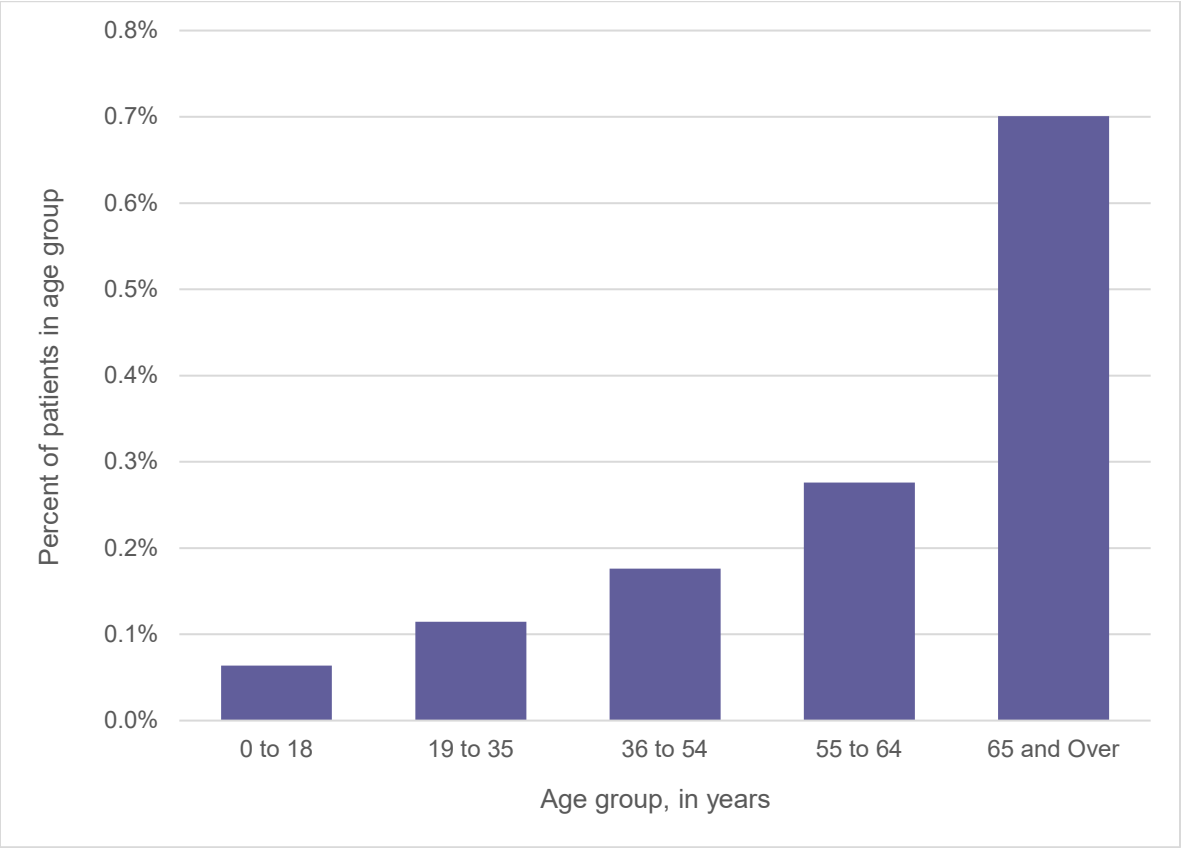

Figure 10. Patients diagnosed with heatstroke as a percentage of patients who received medical services nationally by age group, May-September 2016-2021

As with heat stress and heat exhaustion, more males than females were diagnosed with heatstroke (figure 11). The gender distribution was similar to that for heat exhaustion, with males constituting 64 percent of the diagnoses and females 36 percent.

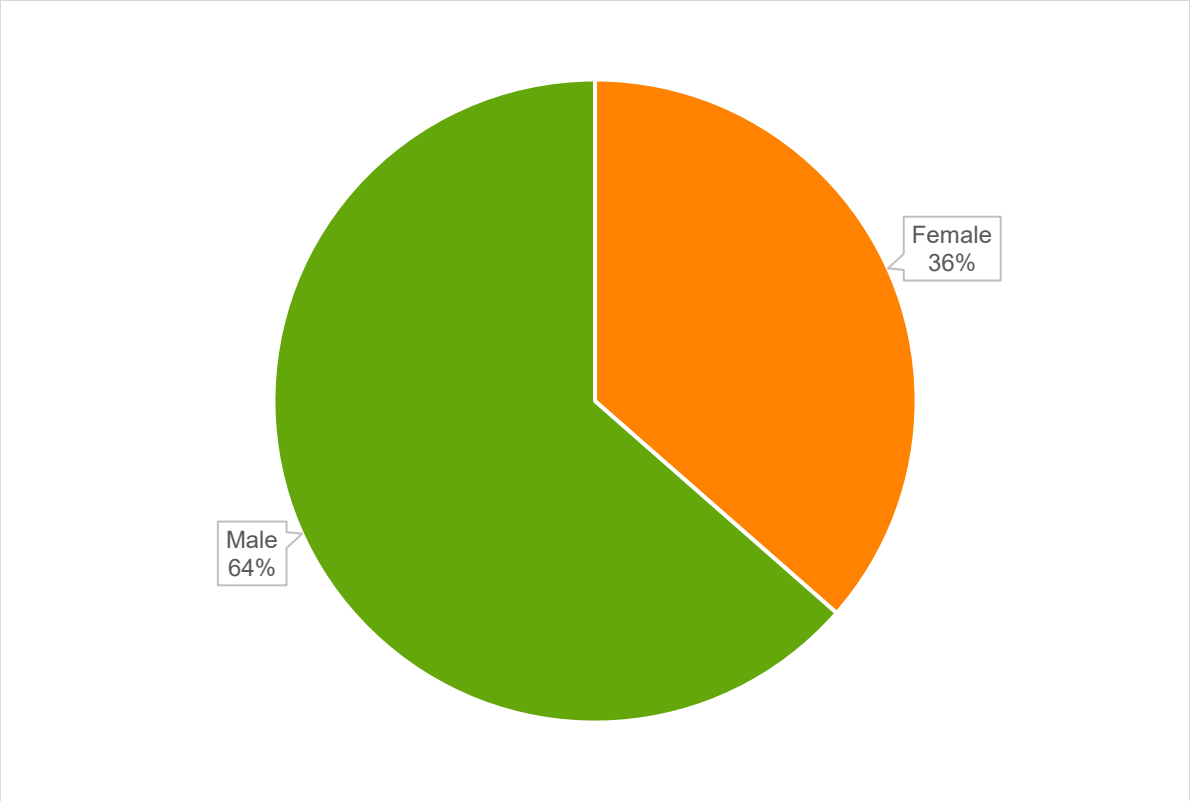

Figure 11. Patients diagnosed with heatstroke by gender nationally, May-September 2016-2021

In every age group, as with heat exhaustion, males were diagnosed with heatstroke more than females (figure 12). As with heat exhaustion, the greatest percentage of females with heatstroke was in the age group 0 to 18 (44 percent), and the greatest percentage of males with heatstroke was in the age group 55 to 64 (69 percent).

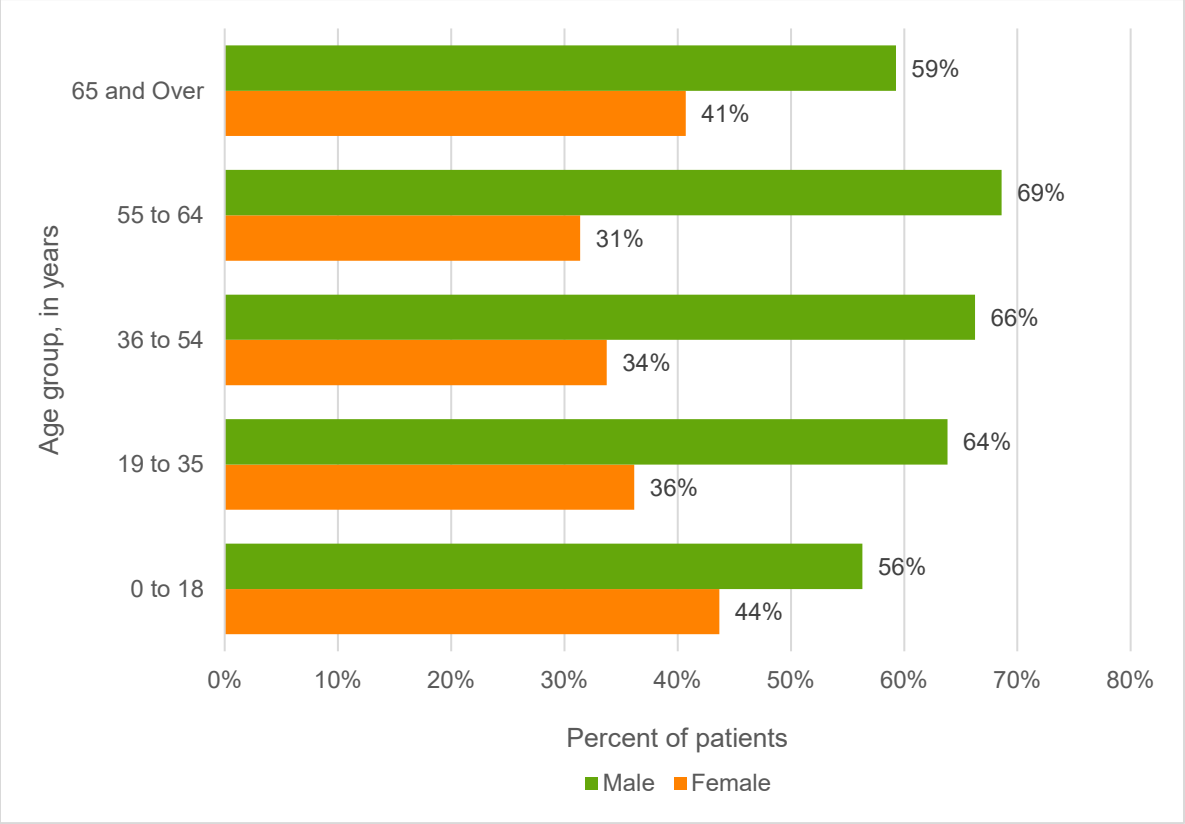

Figure 12. Patients diagnosed with heatstroke by age group and gender nationally, May-September 2016-2021

Conclusion

This study of heat-related illnesses in the United States made several notable findings. In every month from May to September, the percentage of patients who were diagnosed with heat stress, heat exhaustion or heatstroke increased when comparing a month in 2016 to the same month in 2021. Of the three heat-related illnesses studied, heat exhaustion had the greatest increase from one month of 2016 to the corresponding month of 2021 (52.5 percent in June), followed by heatstroke (40.1 percent in September) and heat stress (37.8 percent in May).

This report found that the percentage of patients with heat stress, heat exhaustion or heatstroke diagnoses increased with age, with the greatest percentage found in the age group 65 years and older. More males than females were diagnosed with the three heat-related illnesses studied. The distribution by gender was relatively similar for heat stress (males 52 percent, females 48 percent), but there was greater gender disparity for heat exhaustion and heatstroke (for each, approximately 64 percent were males and 36 percent were females).

Males were more likely than females to be diagnosed with heat stress in the age group ranging 36 years and older, while in the age range 35 years and younger, females were more likely to be diagnosed with heat stress. For heat exhaustion and heatstroke, males were more likely than females to be diagnosed in every age group. For all three heat-related illnesses studied, the largest disparity between males and females in percentage of diagnoses was in the age group 55 to 64 years.

The findings in this report have implications for all healthcare stakeholders concerned with heat-related illnesses, including patients, providers, payors and policy makers. FAIR Health hopes that these findings will also be starting points for further research on heat-related illnesses, as global temperatures increase and such illnesses become more prevalent.

About FAIR Health

FAIR Health is a national, independent nonprofit organization dedicated to bringing transparency to healthcare costs and health insurance information through data products, consumer resources and health systems research support. FAIR Health qualifies as a public charity under section 501(c)(3) of the federal tax code. FAIR Health possesses the nation's largest collection of private healthcare claims data, which includes over 39 billion claim records and is growing at a rate of over 2 billion claim records a year. FAIR Health licenses its privately billed data and data products—including benchmark modules, data visualizations, custom analytics and market indices—to commercial insurers and self-insurers, employers, providers, hospitals and healthcare systems, government agencies, researchers and others. Certified by the Centers for Medicare & Medicaid Services (CMS) as a national Qualified Entity, FAIR Health also receives data representing the experience of all individuals enrolled in traditional Medicare Parts A, B and D; FAIR Health includes among the private claims data in its database, data on Medicare Advantage enrollees. FAIR Health can produce insightful analytic reports and data products based on combined Medicare and commercial claims data for government, providers, payors and other authorized users. FAIR Health's free, award-winning, national consumer websites are fairhealthconsumer.org and fairhealthconsumidor.org. For more information on FAIR Health, visit fairhealth.org.

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