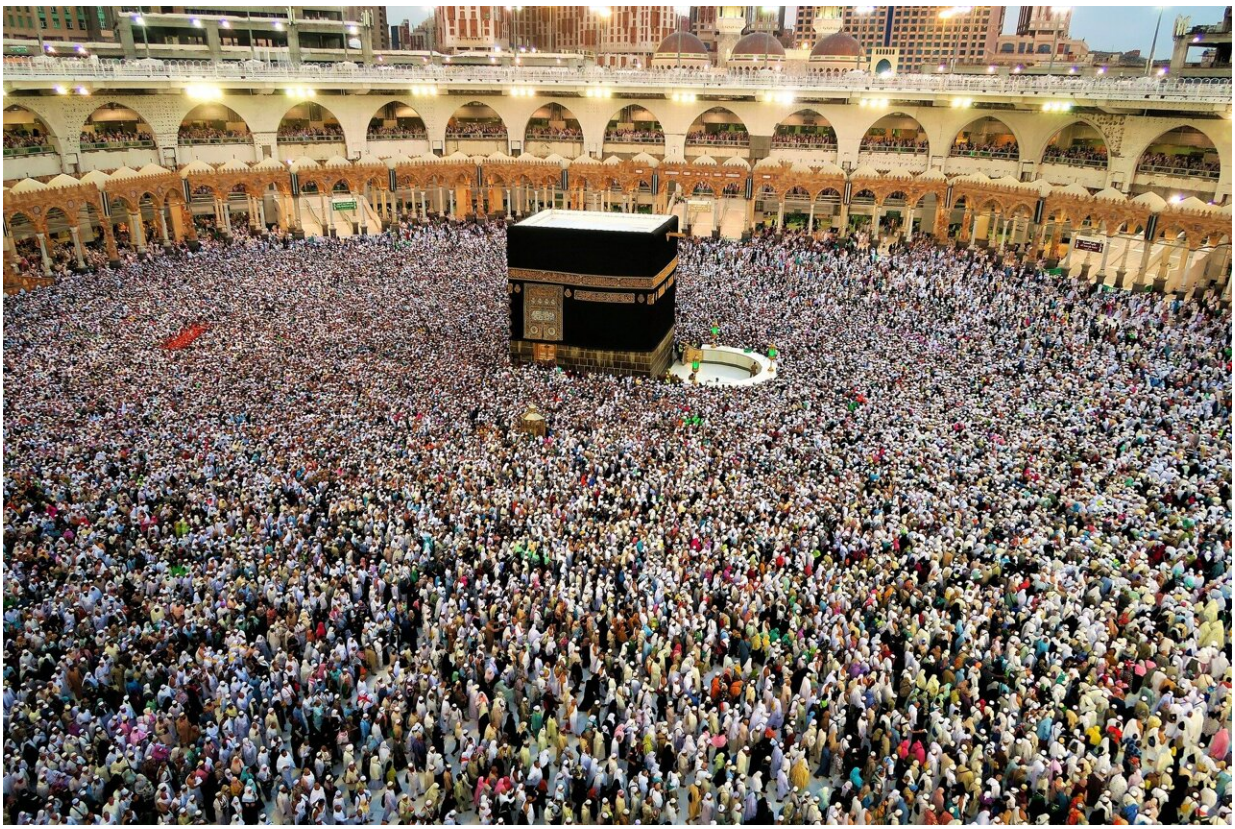
More than 1,300 Hajj pilgrims died this year when humidity and heat pushed past survivable limits—it's just the start

December 19 2024, by Emma Ramsay and Shanta Barley



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Every year, hundreds of thousands of Muslims undertake the Hajj—the sacred pilgrimage to Mecca. In 2024, the pilgrimage took place in mid-

June, the start of the Saudi summer.

But this year, more than 1,300 pilgrims never made it home. Lethal heat combined with humidity proved deadly.

Our new research published in *Nature Climate Change* shows the upper limits of human heat tolerance were breached for a total of 43 hours over the six days of Hajj. During these periods, heat and humidity passed beyond the point at which our bodies are able to cool down.

Scientists are increasingly worried about the death toll caused by humid heat waves, and how it will escalate in the near-term. This year is now the hottest year on record, overtaking the previous hottest year of 2023.

So why was the pilgrimage so deadly? And what does it mean for us as the climate changes?

What happened in Mecca?

As the planet gets hotter, it is also becoming more humid in many places, including arid Saudi Arabia. Since 1979, periods of extreme humid heat have more than doubled in frequency globally, increasing the chance of lethal events like this.

To do the Hajj, you have to walk between six and 21 kilometers each day. Many pilgrims are older and not in good health, making them more vulnerable to heat stress.

This year's pilgrimage started on June 14. Over the next six days, the temperature topped 51°C, while "wet-bulb temperatures" (the combination of temperature and humidity) rose as high as 29.5°C.

June is typically the driest month in Saudi Arabia with average relative

humidity around 25% and wet-bulb temperatures averaging 22°C. But during this year's Hajj, humidity averaged 33% and rose as high as 75% during the most extreme periods of heat stress.

Our research shows heat tolerance limits for older adults were breached on all six days of Hajj, including four prolonged periods of more than six hours. On one ferocious day, June 18, humid heat hit levels considered dangerous even for young and healthy pilgrims. The points at which wet-bulb temperatures enter the lethal zone depend on the exact combinations of temperature and humidity, because our bodies respond differently to dry or humid heat.

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