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When Climate & Cardiology Overlap: How Climate Change Can Impact Heart Health

Dr. Butler:
As global temperatures continue to rise, experts are calling attention to the devastating effects this can have on human health. Cardiovascular mortality is especially a concern as two recent studies from the University of Pennsylvania outlined a connection between these two health risks. So what exactly do we need to know when it comes to the impact of climate change on cardiovascular health?

Welcome to *Heart Matters* on ReachMD. I am Dr. Javed Butler. And joining me today to discuss his two studies focusing on this important topic is Dr. Sameed Khatana, Assistant Professor of Medicine at the Perelman School of Medicine at the University of Pennsylvania and a physician at the Philadelphia Veterans Affairs Medical Center.

Dr. Khatana, welcome to the program.

Dr. Khatana:
Thank you. Nice to be here.

Dr. Butler:
So there's a lot written about climate change and its effect in general but also related to health. But particular to cardiovascular mortality, can you give us some background as it relates to extreme heat and cardiovascular mortality and risks?

Dr. Khatana:
Yeah. That's a great question. So we know that the cardiovascular system plays an important role in the body's physiologic response to heat exposure. The human body can only function in a relatively narrow window optimal core body temperature, and when there's an increase in this internal or core body temperature, whether it's due to heat exposure, physical exertion, fever, etc., various mechanisms within the body will try and reduce that temperature. And so this is primarily orchestrated in the brain, in the hypothalamus, and so in response to signals from the brain as well as other receptors within the body, the heart will beat faster and harder to try and transport heat away from the internal organs to the periphery via blood. So the cardiovascular system is the primary transport mechanism of heat within the body. And so this extra strain on the heart can therefore be challenging for individuals who may already have cardiovascular conditions as well as certain cardiovascular risk factors, such as diabetes, or are on certain medications, like beta blockers or diuretics.

So we know from previous studies that heat exposure can lead to a higher risk of heart attacks and strokes, and some other studies in the past have noted that in certain cities or in certain specific heat events that there might have been an increase in cardiovascular mortality as well. However, what has been lacking so far was an analysis that incorporated all or most of the country across multiple years using relatively contemporary data, and so seeing this gap in the literature we decided to address that.

Dr. Butler:
So with that background in mind, let's just now zero in on the two studies that you performed. Can you just tell us what exactly was

analyzed? What was the question? What were the sources of data?

Dr. Khatana:
So there had been some previous studies examining cardiovascular health in relation to extreme heat. Most of those have been limited to certain areas, particularly cities, and typically just around certain heat events. And so one very common heat event that's been studied in the past is the Chicago heat wave in the mid '90s. In 2003, you might remember there was a big heat wave in Paris. And so there have been some studies that have focused on those individual heat waves, and I think they pointed towards some important findings, that cardiovascular health might be impacted by those heat waves.

But what was lacking was a more thorough understanding across the entire country. And why is that important? It's important because the relationship between heat and mortality is going to be impacted by the environment, the structure, the infrastructure of where people are living, whether there's access to greenery, a tree canopy, etc., and so we thought that analyzing a broader swath of the country would allow us a better understanding of what is happening to cardiovascular mortality in relation to extreme heat.

The second thing I should point out is that no study so far has really been able to say how many cardiovascular disease-related deaths have occurred due to extreme heat. And we think that's important because, as you probably know, extreme heat is increasing in frequency, intensity, and duration year after year over the last 30 to 40 years, and it's projected to continue to increase over the next several decades.

So in order to answer these questions, we separated our analysis into 2 questions. The first question was, what is effect of extreme heat, or what is the association of extreme heat with all-cause mortality? And then the second part of that question was, what is the association of extreme heat with cardiovascular disease-specific mortality? And so the first analysis was published in *JAMA Network Open* in May, and then the second analysis was published in *Circulation* a lit bit later. And so both of these studies used mortality data and temperature data that we acquired from the CDC, and it examined deaths in summer months for all adults 20 years of age and older between 2008 and 2017 across all counties in the contiguous United States, which consists of the 48 mainland states and the District of Columbia. So that was the setup for the two studies.

Dr. Butler:
And what were the findings?

Dr. Khatana:
In both studies, we found that on average, as the number of extreme heat days per month increased in a particular county, the number of deaths, whether they were from any cause or from cardiovascular disease specifically, also increased. And so what we found was that for each one additional extreme heat day per month, there was an increase in 19 deaths from any cause or around 3 deaths from cardiovascular causes per 10 million people. And so these numbers might not seem large at first glance, 19 per 10 million people or 3 per 10 million people, but when multiplied across all summer days across the entire contiguous United States, we estimated that, depending on the definition of extreme heat that we used, the total number of excess deaths from any cause associated with extreme heat in that study period was approximately 13,000–20,000 deaths from any disease or approximately 6,000–7,000 deaths from cardiovascular conditions.

Dr. Butler:
For those just joining us, you're listening to *Heart Matters* on ReachMD. I am Dr. Javed Butler, and I'm speaking with Dr. Sameed Khatana about climate change and its impact on cardiovascular mortality.

Boy, I am really intrigued now, so I have a few questions. Do you think that southern half of the United States where the temperatures are higher to begin with there is some sort of adaptation that in the summer months when the heat is very high, the body is kind of used to it and tolerates it better as opposed to, say, the northern areas where the summer temperatures are not that high, but all in all there's more swings in temperature?

Dr. Khatana:
I think that's a great question, and I'm glad you brought it up. When we explored our findings a little bit further, we also wanted to look at

heterogeneity of this association in different areas. I'll mention our analysis is a county-level analysis, and so it's difficult to say what is happening on an individual level, but we can say that in counties with more extreme heat days, there's more people who are dying from cardiovascular conditions.

One of the subgroup analyses that we did was we broke up the counties into groupings based on the total number of extreme heat days that occurred. So unsurprisingly, the most of our extreme heat days occur in the South and parts of the Southeast and certain parts of the Midwest as well, and the fewest, as you mentioned, occur in the Northeast, some parts of the upper Midwest. And so when we look at the actual association, meaning how many additional deaths were occurring due to 1 additional extreme heat day, we found that the counties with the fewest number of extreme heat days had a stronger relationship than in the counties where there's more heat days occurring.

And so why could this relationship occur? Could there be something physiologic? I think that's possible. But I think one thing that probably is likely is that there's differences in culture and infrastructure and people's awareness of extreme heat, so areas of the country that perhaps have not been exposed to this in the past, local governments probably aren't ready for when extreme heat occurs, getting people to cooling centers and making sure people have access to air conditioning. Maybe even people themselves might not be aware that extreme heat is an issue, and so people who lived in areas where extreme heat happened more frequently might know to take those precautions where people in other areas might not.

Dr. Butler:
Can you give us some of your biggest takeaways, but more so what future research holds in this direction, and what are some of the strategies that can be implemented to mitigate some of these issues?

Dr. Khatana:
I think the main takeaway is that yes, extreme heat is causing or most likely associated with excess deaths, whether they're from any cause or specifically related to cardiovascular health. Some estimates suggest from previous studies that cardiovascular disease might be the single biggest contributor of deaths related to extreme heat compared to any other cause, and our analysis suggests that maybe around half of the deaths that have occurred or excess deaths that have occurred due to extreme heat might be due to cardiovascular disease, and so that's one of the major takeaways.

We also found that men had a significantly greater association between extreme heat and cardiovascular mortality as well as all-cause mortality compared to women. And then when we looked at subgroups of race and ethnicity, we found that non-Hispanic Black adults had a significantly greater increase in cardiovascular mortality compared to white adults when exposed to extreme heat as well.

Several previous studies have shown that in neighborhoods that have more minority populations, there's less tree cover; people have lower access to air conditioning; there's more of what's called an urban heat island effect, which means that urban built-up areas warm up faster than surrounding rural, less built-up areas; and we already know the disparities that exist in healthcare access and other structural issues. And so some of the differences that we're seeing between populations are likely related to these structural issues rather than just physiologic or healthcare-related issues.

In terms of future directions, we would really like to identify specific populations that are most being impacted by this. So one population that I'm particularly interested in is the homeless population. We know that homeless individuals, unfortunately, have very high burden of cardiovascular disease, cardiovascular risk factors. They also have very poor access to healthcare resources and almost by definition are very exposed to the elements, and so what impact are climate factors, like extreme heat, having on this particularly vulnerable population? I think we shouldn't pretend and say that there are simple solutions. This is a very complex problem involving systems that span the globe affecting people at many different levels, and obviously, in the long-term, national and global policy to address climate change are needed, but in the short to medium term, there are things that local, state, and maybe the Federal Government can do to prepare areas for extreme heat. So things like heat action plans, those more or less ensure that there's access to cooling for individuals, particularly vulnerable individuals, when extreme heat does occur, and oftentimes that's in the form of cooling centers, so community centers, high schools, various areas where people can gather in a setting of extreme heat.

Then there's other measures as well. In many states, particularly in the Northeast, utility companies are not allowed to shut off power, say, when there's extreme cold. I would say municipal governments understand the devastating fact cold can have, but many areas don't really give as much weight to heat. So ensuring that we don't have power cut off in the middle of an extreme heat wave, I think those kind of policies are very actionable items that can be done in the short term rather than just thinking that, well, climate change is a big issue, it can't be solved, and sort of punting this thing down the road.

Dr. Butler:
Well this has certainly been an incredibly important and fascinating topic to discuss, and I really want to thank my guest, Dr. Sameed Khatana, for sharing his insights on the impact of climate change on the cardiovascular health. Dr. Khatana, it's been an absolute pleasure speaking with you today.

Dr. Khatana:
Great. Thank you so much.

Dr. Butler:
For ReachMD, I'm Dr. Javed Butler. To access this and other episodes in our series, visit ReachMD.com/HeartMatters where you can Be Part of the Knowledge. Thanks for listening.