The Science of Heat and Our Bodies Part Two: Beat the Heat

Sun, 8/22 5:22PM 25:08

SUMMARY KEYWORDS

heat, heat exhaustion, athletes, exertional, people, risk factors, exercising, heatstroke, temperature, acclimatized, illness, heat stroke, long, physical fitness, talking, working, day, research, higher, dehydrated

SPEAKERS

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Ricky Telg 00:04

This is Science by the Slice, a podcast from the University of Florida's Institute of Food and Agricultural Sciences Center for Public Issues Education. In this podcast, experts discuss the science of issues affecting our daily lives, reveal the motivations behind the decisions people make, and ultimately provide insight to solutions for our lives.

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Phillip Stokes 00:28

I'm Phillip Stokes, Education Coordinator with the PIE Center, and welcome to part two of our series on heat related illnesses. And in this episode, we're focusing on athletics. And speaking of athletics, most of you are probably aware that the Summer Olympic Games recently concluded, which is always really exciting and so fun to watch. I think so anyway. And this year, one storyline you may not have heard about is the heat that the athletes, staff and volunteers had to endure. The Tokyo Summer Games were one of the hottest games on record, possibly the hottest, with temperatures pushing 100 degrees Fahrenheit and relatively high humidity, there were incidents of heat exhaustion among athletes and personnel fortunately, all reported as being mild. Organizers of the games knew this would be an issue and put countermeasures in place, such as rescheduling certain events to cooler evenings, having ice jackets and mist sprayers available, and two endurance events

were even moved to a location about 500 miles north of Tokyo, where temperatures are usually much cooler. It's clear that he is a huge consideration for outdoor sporting events. With that in mind, I talk to an expert on the issue, Dr. Rebecca Lopez, an associate professor in the athletic training department at the University of South Florida. Dr. Lopez has a background working with athletes in preventing and treating heat illnesses, as well as conducting research on the topic. Here's Dr. Lopez talking about how she started researching heat illness and hydration.

R **Rebecca Lopez** 02:02

I've been doing research related to heat illness and hydration for quite some time I was working clinically, in Miami, Florida as an athletic trainer working with athletes usually in the high school setting. And because of being out there in the heat and humidity, I saw a lot of heat illnesses, so I got interested in the research aspect and basically making sure that the research questions that we're asking are able to be clinically applied in the real life setting both at the you know, high school athletes, collegiate athletes, and anybody basically, that's exercising or working outside.

P **Phillip Stokes** 02:33

That's great. And you mentioned, you did a lot of work in Miami, of course, you're now in the Tampa area, I'm in the Gainesville area. Heat, we know heat, it's unavoidable here. And of course, in so many other places as well, what goes into the preparation of being out in the heat getting ready to, you know, have maybe a long day, a long tournament, or just a sporting event, something like that.

R **Rebecca Lopez** 02:58

Yeah, so the preparation goes, you know, takes a lot longer than just the day of so obviously, your physical fitness, you know, your fitness status really plays into it. But when somebody is going to be exercising the heat, they really need to make sure that their heat acclimatized, making sure that their body is actually used to exercising and the heat and is physiologically adapted to the demands and the heat stress that's going to be placed on them. So obviously hydration, making sure they're heat acclimatized and making sure they have proper nutrition, they've slept enough. There are a lot of different factors and actually risk factors to heat illness. So it got a lot goes into the the planning of that to make sure people are exercising safely.

P **Phillip Stokes** 03:37

What are some of the challenges that can arise for athletes in that preparation or day of like when they're when they're out there as well? because like you said, it's not the day of it's not the day before? So what are some of the challenges with that? And and what are some of those risk factors? I thought that was an interesting point you made as well.

R **Rebecca Lopez** 03:54

Yeah, so I think the challenge could be, you know, us, we live in Florida, and so it's hot and humid every day. So if you're training and your practices and all the training that you're doing is happening outside, you're already doing the right things in terms of preparing for the competition, the day of the game, etc. The challenge could really come in, you know, for any kind of athlete that travels to participate. So for example, you know, you have a team from New England coming down to Tampa area, there's going to be more that goes into it. And that's definitely gonna be a challenge to making sure that those athletes are heat acclimatized. As far as risk factors, you know, there are some intrinsic and extrinsic factors, intrinsic ones being, you know, body composition, tends, people that have higher body fat tend to be at higher risk for heat illness. There's also different improper work to rest ratio. So from a programmatic standpoint and a coaching standpoint, if somebody is not giving them adequate rest, those are some of the extrinsic factors in proper work to rest ratios. And basically, somebody's physical fitness does not match what they're being asked to do. So if I were to go out for a run, right now and it's hot, I probably just naturally just slow down and not perform the best. But if you have somebody that is dictating how hard you're supposed to be working, the timing, the duration of it, they're blowing the whistle, you have to be back on the line, and things of those nature, that nature that that's really where some of the risk factors come into play.

P **Phillip Stokes** 05:18

So how can heat related illnesses be prevented? And what is the type of education you do with athletes, student athletes, as well, as coaches, you talked about that as well, maybe sometimes the coaches are dictating how hard that athlete is going to work.

R **Rebecca Lopez** 05:36

Yeah, there's a lot of education that goes into it. You know, if you know, the risk factors, both the the internal intrinsic risk factors as well as extrinsic ones, it kind of helps from the preventative standpoint. So for example, making sure I didn't mention environmental conditions, obviously, you know, we talked about it, but that's definitely a risk factor. So the hotter it is, the more humid it is, the more at risk those athletes are going to be. So from a coaching standpoint, it's you know, scheduling practices training, not at the

hottest time, the most humid time of the day. So making sure that it goes into the organizational planning of when is your practice going to be, how long is it going to be, how intense is it going to be? Are they going to be required to wear a uniform equipment. So making modifications, you know, if we canceled practice, every time it was hot outside, we would never have practices in some areas, so but you could always make modifications. So even if that means it's like, a real scorcher, sometimes it's really hot, really, humid, practices absolutely should be canceled. Other times, it's hot and humid, but maybe give more rest breaks in between, maybe allow them to take off, you know, for football, for example, take off the shoulder pads and helmets for conditioning part. So a lot of that education could really help with the preventative aspect.

P Phillip Stokes 06:52

What about, what about age as a risk factor is that I know, we've been talking about student athletes a lot. So we're in that like, teenage to, you know, low 20s kind of age, but of course, life goes on. So what about that?

R Rebecca Lopez 07:07

Yeah, it's really interesting, a risk factor for age, there's not too much research on it, there is a belief that, you know, the elderly population is definitely at risk, the thermoregulatory system is not, you know, in the peak shape that it was, you know, as you as you're when you're younger, so that is definitely a concern. So if you're talking about much elderly, you know, elderly people who have decreased ability to sweat, for example, or diminished thermoregulatory system, then that could be at risk. Same thing happens with babies, you know, younger Toddlers and Babies, that they're just their thermoregulatory system is not as developed, so they're not able to. So that's always a risk factor. But if you're talking about an endurance athlete, for example, there are runners, ultra marathon runners, triathletes that are of an older age, and they've been exercising for a long time, they're probably superheated acclimatized. And so it's not that I haven't seen too much that shows that those are the athletes that are getting heatstroke and heat illness, although it could happen for the most part because of their training, their physical fitness and, and the acclimatization the risk is not as bad.

P Phillip Stokes 08:15

So what does it look like when there's an HRI incident on the field or in any sport related scenario?

R Rebecca Lopez 08:24

Sure, so so there's different exertional heat illnesses, and they range in severity. So if you're talking about the most minor, least severe heat illness, you're talking about heat cramps, which sometimes people have muscular cramps that are not associated with the heat at all. But if you're talking about somebody that is, you know, new to the heat, and their calves are cramping up and things of that nature, that's not that severe. And it could be you know, due to muscle fatigue, sodium depletion or even dehydration. It's kind of unknown what actually causes heat cramps, but they're not as big of a concern. The more common ones that you'll see are heat exhaustion and heat stroke. And those actually present similarly sometimes heat exhaustion is is more due to dehydration, lack of electrolytes not being heated climatized and because you're exercising, cardiovascular systems working to get you know, oxygenated blood all over your body and also bringing blood to your skin to help dissipate that heat. Your body just can't maintain that exercise. So you end up stopping exercise because you're fatigued, you feel lightheaded, you're dehydrated, things of that nature. Whereas exertional heatstroke, you're talking more about a thermoregulatory overload. So because, you know, lack of heat acclimatization, environmental conditions, high exercise intensity and duration of the athletes body's temperature just keeps rising and elevating to dangerous levels. And at that point, it starts to look a little bit differently because you have central nervous system dysfunction, you know, meaning that the person is going to start either collapse and be unconscious or even just kind of acting out of swords, disoriented, confused, just not making sense and their body temperature is going to be about 105 or higher, so a very serious medical emergency that somebody could actually die from. So, in the beginning, if you see somebody collapse in the heat, and they just kind of not feeling well feel like they're gonna pass out, it could be heat exhaustion. But if they have obvious central nervous system systems of dysfunction and their core body temperature is at 105 or higher than it's you're looking at a medical emergency and the potential for that person to die if they're not treated adequately.

P Phillip Stokes 10:28

So what is the treatment for that?

R Rebecca Lopez 10:31

Great question. It's really interesting, I think it's the only medical emergency where we could definitively say that if you recognize that if somebody is having exertional heatstroke and are able to give the appropriate treatment on site right away, it's 100% survival. And the key for the treatment for exertional heat stroke, is getting that body temperature down as soon as possible, which is done through cold water immersion. So

any kind of tub, kiddie pool anywhere where you could immerse that patient into a cold water with ice and get that temperature to drop to below that critical threshold of 105 is the key to survival.

P Phillip Stokes 11:09

So I guess let's talk a little less extreme, because you know, a lot of the people listening are, you know, maybe not competing at that level. So what would you say? If like, people are feeling, you know, maybe some of that lightheadedness, but maybe not quite at that point, just going inside into the air conditioning? Maybe put a cool towel on your head? What are some of the things that you can do in a less extreme situation? I guess?

R Rebecca Lopez 11:33

Yeah. So I think I would say heat exhaustion is definitely a lot more common, and something that if somebody starts to feel lightheaded, they have a headache, they're probably dehydrated, I feel like they're gonna pass out or nauseous. Like, the key is to try to also cool the body down and rehydrate. So yes, definitely going into the air conditioning, if that's an option, if that's not an option, maybe somewhere shaded with the breeze, you know, I know you can't predict where the breezes but if that's an option, for sure, cool towel over the head, if they if they feel like they're able to drink fluids and cold water or even an electrolyte sports drink or something like that would be helpful.

P Phillip Stokes 12:09

Now we're kind of leaving sort of that practical application, how do you research that and kind of what's the latest in the field, as far as kind of learning more information about that?

R Rebecca Lopez 12:21

Yeah, it's really interesting research in this area, because there's a lot of different ways that you could research it. First, the first thing you could do is do what you know, historically people do is a lab study where you have a very controlled situation in a lab. Sometimes people use a heat chamber where you could control the environmental conditions. And then you could have somebody do some kind of exercise task whether it's on a treadmill or a bike, or anything else you could do and you know, monitoring their core body temperature, their heart rate, their sweat rate, things of that nature, those are pretty common measures for this type of research. Another thing you could do is an observational study, which is what I like to do, because I like to examine people when

they're out in their actual setting, and actually not control at all what they're doing, but rather observe and take measurements as they're doing what they normally do. So for example, if you're talking about a football team, a tennis player, or even anybody that's working out in the heat, you know, just being able to take core body temperature, heart rate, their thirst or measure them to see how much sweat they've lost, and be able to give recommendations based on that. And then last, another very common and I think what we're seeing a lot more in the research now is more of a retrospective study where you look at the epidemiological information on heat illness so basically injury rates, seeing how many heat illnesses happen, when do they happen? What were the environmental conditions when they happen? And we learn a lot by looking kind of back and seeing what those injury rates are, so that we could then prevent people from having exertional heat illnesses.

P **Phillip Stokes** 13:58

What are some of the physiological things going on? Like what is and you and you did touch on this some, but like what's happening in your body? And if it's if there's dehydration involved, what's going on with your kidneys to just kind of what's happening internally, we know what it looks like on the outside now, but what about on the inside?

R **Rebecca Lopez** 14:16

Yeah, so for for heat exhaustion, you know, you have what they call cardiovascular insufficiency, where you just don't have enough blood in your body. And the more dehydrated you are, the less blood you have in your body to really try to cool the body down. The main way that we call our bodies down is through evaporation of sweat from the skin. So if it's a) really humid outside or you're dehydrated, you're not able to really get that sweat to evaporate from your skin. So that's what's happening with exertional heat exhaustion. So there's not enough blood. Basically, you're you're unable to continue working in those conditions. And all that when you're talking about exertional heat stroke or somebody's temperature is 105 or higher. The body actually starts to breakdown, cells start to die, your kidneys start failing, your liver starts failing. And you have just kind of what they call explosive rhabdomyolysis as well, where you have muscle muscle damage. And basically, as that temperature continues to rise, you know, we've seen in cases of exertional heatstroke with people at 107, 108, 109. And so there's just a whole cascade of events that's happening where your organs are slowly starting to not function anymore. Some of your liver enzymes, for example, start leaking. So that would be one of the things that you see like on a blood, you know, you get your lab tests and stuff like that. So basically, entire shutdown of your body with exertional heatstroke, whereas heat exhaustion is more like you don't have enough fluid in your body. And so you start to have

those symptoms and stop yourself from continuing.

P **Phillip Stokes** 15:49
Are there any long term effects, if you have one of these scenarios happen to a person or an athlete?

R **Rebecca Lopez** 15:57
Usually with heat exhaustion, there are not so with heat exhaustion, you just need time to recover to rehydrate, get rid of you know, recover so that you're not fatigued. The one thing I'll say is, is if you don't change anything, like you have heat exhaustion, and you don't, you're still heat unacclimatized, or you're still not hydrating properly, you're still working too long, or exercising for too long in the heat, those things are not gonna go away, right. So if you don't change anything, you're just you're more likely to have a heat exhaustion, because you're not changing the behavior or the environment in which you're exercising. With heatstroke, you absolutely can have residual complications. So if somebody temperature stays elevated too long, they're not cooled fast enough, they tend to become heat intolerant. So you basically damage that thermoregulatory system. So somebody may not be able to tolerate heat anymore. More likely to have another heatstroke, depending on the damage and how long the temperature is up there. They could have cardiovascular issues, they can have liver and kidney issues, there have been some patients that needed liver transplant or kidney transplant after that, so it could be anywhere from if somebody is with exertional heat stroke, for example, you recognize they have a heat stroke, they're cooled on site. And a lot of times people have no issues at all. So as long as you address the reason why they had the heat stroke, they should be fine to continue working or exercising. But if there are residual effects, it's usually because their temperature stayed above that threshold for too long.

P **Phillip Stokes** 17:26
What's some advice you would give the lay person I'll say? So the non like athletes? What advice would you give to to people who are still working in the sun, and they're still certainly at that risk, but maybe don't have the proximity to a trainer or to a coach or someone that's going to be able to maybe recognize some of those things?

R **Rebecca Lopez** 17:48
Right. So I would say adequate nutrition and hydration is really important. If they're working outside, they're probably already acclimatized to the heat. One of the main

things I've seen is also not exercising or working in the heat if you are sick and have a fever. So if you had a stomach virus, for example, you're dehydrated, or you have another virus and you have a fever, you should avoid exercising or working in the heat because your temperature is going to be up, you're going to be dehydrated, and you're basically creating this perfect storm of risk factors and then going to exert yourself in the heat. And that's a really bad combination. One thing that I tell people all the time, which workers might not always be able to prevent this, but the lay exercise person will is please avoid exercising in the middle of the day when it's the hottest I mean, I always have I had a coworker the other day was like you're going to be mad at me but I went for a run at one o'clock and it was really bad. I was just like, why did you do that? I would also definitely say if you are, for example, somebody who's working in the heat is have scheduled breaks where they're able to not just get hydration, but also actually rest because if your body temperature is going up, those rest breaks especially if it's in the shade, if you're able to go to your car in the air conditioning for a little bit, actually helps your body recover and brings helps bring your temperature down so that you could then safely return to work after the break.

P Phillip Stokes 19:06

Are there any stories or any cases that maybe you could share that would kind of help us understand a little bit more about how this can happen?

R Rebecca Lopez 19:17

Right. So what we have seen from epidemiological standpoint and looking at the cases of exertional heatstroke and this has actually happened in like in the military setting, with boot camp and initial training as well as preseason for athletes, is that the risk of a heatstroke is usually the highest those first couple of days because their body is not accustomed at all. If you think about especially if people are off in the summer and then starting a preseason in August, or they're just joining the military, for example and getting sent somewhere that's very hot and humid. There's always going to be an increased risk of those exertional heatstroke cases and collapse from the heat. There's those first two days. So I think from from a prevention standpoint, what we've seen is, if the initial training initial work, even somebody is working in the heat is a gradual progression of amount of time that they're working or exercising with a bigger rest break, and then gradually, day by day over the course of a week or two is that increase in time duration, increase in intensity, and things of that nature that really, really works. We've seen that with collegiate athletes, we've seen it before with professional athletes. And we even see it in then the industrial work setting, where if somebody has a regimented, progressive, acclimatization schedule, where they gradually increase the amount of work, and have

longer rest breaks, initially, that really has been shown to prevent exertional heat stroke and death from exertional heat stroke, because the people are now you know, two, three weeks in, they're already their bodies are used to it. So it becomes less of a risk.

P Phillip Stokes 20:55

Do you have any any last thoughts? Before we close out today, anything maybe I didn't ask or that you just want to touch on before we go.

R Rebecca Lopez 21:04

I would, I would add that prevention goes a long way. So knowing what those risk factors are both from a personal, you know, intrinsic factors in terms of like his physical fitness levels, acclimatization, history of illness or viruses in the last couple days, that really helps. And then from an organizational factor, making sure that allowing time for that acclimatization, making sure that there's adequate rest time in between activities and access to fluids during all that, that really helps. With that being said, we've also seen that even though you can't prevent necessarily every single heat illness, exertional heat stroke death is definitely preventable. So if you have workers, athletes, any kind of group of people that are exercising or exerting themselves in the heat, having access to cold fluid, as well as some measure or ability to cool somebody down, really helps to prevent not not only the heat, heat illness from happening, but to help treat them if it does happen. So I think those are really important key factors to have. And I think the last thing that I will say too, is based on the research and what we see in actual cases of heatstroke and all that. It's really important, especially from an organizational standpoint to have some kind of heat safety policy. So whether it's workers or athletes, you know, the organization could set up, for example, a new employee starts, you're going to be heat acclimatized you're in the heat acclimatization protocol, which means you could only work this long and gradual, you know, gradual progression of work. If you're an athlete, you know, you can't do two days a first day you can't do full football gear the first couple days. So having some kind of heat safety policy that has prevention guidelines in it, as well as recognition and treatment guidelines, I think really helps establish an understanding especially for an organized sport, organized work situation where it helps, you know, decrease that risk overall for for the organization, as well as for the individual athletes or workers in that setting.

P Phillip Stokes 23:18

I want to thank Dr. Rebecca Lopez for being on science by the slice and sharing information from her research, experience and providing practical tips for anyone

participating in or managing outdoor activities. At the beginning of the episode, I talked about the high temperatures of the Summer Games in Tokyo. But what are some of the ramifications beyond this event? Many experts are predicting changes in how sports are run due to a warming climate. Take next year's World Cup for instance, which will take place in Qatar. Due to the intense heat of the region it will run during November and December of 2022 instead of the usual May, June or July. What other changes will we see due to rising global temperatures? What changes should we see whether in occupational working environments, athletics or other settings. For more information on the topic, you can go to the website of the Southeastern Coastal Center for Agricultural Health and Safety, a partner program with the PIE Center. That's SCCAHS.org. I'll include a link in the show notes. As always, I want to thank everyone involved in Science by the Slice. Michaela Kandzer, Rachel Rabon, Valentina Castano, Sydney Honeycutt, Ricky Telg, Ashley McLeod-Morin and Alena Poulin. I'm Phillip Stokes. Stay safe. Stay cool, and join us next time on Science by the Slice