Harry Kennard 0:12

Hello, and welcome to Episode Three of the Climate change and Health podcast. I'm Harry Kennard, and this time I'll be chatting to Giorgos Petrou about overheating buildings and the health risks associated with them. Giorgos is a research fellow in building physics and urban modelling at the Bartlett School of Environment, Energy and resources. He's the UCL researcher of the health protection research units on environmental change and health. He's also involved with the climate care project, which aims to understand the factors that contribute to high indoor temperature and care homes. And on top of all that, he's about to submit his PhD thesis.

Before we dive into the chat, I thought it might be helpful to review some of the health context surrounding the dangers of exposure to heat. A global overview is provided by a study led by Professor Qi Zhao which came out in July 2021. It was published in The Lancet Planetary Health Journal, and it's called "Global regional and national burden and mortality associated with non-optimal ambient temperatures from 2000 to 2019, a three-stage modelling study", so you can look it up if you'd like to read it. The headline finding for from that study is that on average, around 480,000 heat related excess deaths occur worldwide each year, which is just a little under 1% of all deaths. The term excess deaths there is important you might have come across it in discussions of impacts of COVID. It quantifies the number of deaths above the recent average and it allows us to see large population mortality events. It's these events that are then associated in this case with the excess temperature.

The negative effects of heat fairly obviously increase with increasing temperature. What starts out as relatively mild impacts like heat rash, and swollen ankles can become dizziness from dehydration and then heat exhaustion. This starts to happen when the body's core temperature rises above 37 degrees centigrade. The most dangerous point is then heat stroke for which the core temperature exceeds 40 degrees centigrade for extended periods. This can ultimately lead to brain damage, organ failure and death.

In the UK, the greatest hazard occurs in southern England, a recent study by Public Health England of three heat waves to occur in 2020, found over 2500 deaths associated with them. Typically, these deaths are more likely to occur in vulnerable and older populations. There is some suggestion in that study that COVID might have had an impact on the number of deaths that occurred but the exact mechanisms are complex. But what is clear is that not all homes have the same susceptibility to overheating. So here's my chat with Giorgos, as he shines some light on what's going on.

Welcome to the podcast. So today you're going to talk to us about overheating. Before we do that, the listeners I'm sure would be keen to hear about how you got into environmental research and thinking about buildings in the first place.

Giorgos Petrou 2:55

So being interested in the environment, sustainability and climate change probably started when I was in secondary school. And I just took geography as I GCSE. Just because I was interested in physical geography, so the volcanoes and earthquakes and just trying to understand that. And I still remember when we started that section on global warming, and how this you know, this is quite important, potentially can be quite catastrophic. And how it's only really going to get worse from where we're at that point. So it just got me thinking, got me quite interested at that point. And I ended up going for it studying physics for my undergrad. Just because that was my, I guess, first academic lab. So that's that's what I would follow initially. But yeah, well think, bit of research in my undergrad in physics. I felt like, although very exciting, and very interesting thing that research was just still quite far away from some of the big problems we face as a society.

Harry Kennard 4:07

I had the same the same realisation myself, you know, I was doing astrophysics. And I thought, this is fun, but it's not going to really help anyone.

Giorgos Petrou 4:17

Yes, yes. Exactly. Yeah. So I just started looking for, you know, what, what transitions I could make from physics, and I found the LOLO Research Centre on the built environment. And I thought, you know, that's, that's interesting. I thought I can apply my knowledge of physics in the field. But also, you know, there's just a lot of things that would be quite new to me. So that's quite exciting.

Harry Kennard 4:51

Yeah, that's excellent. Yeah. In the introduction I mentioned that you're focusing on overheating mainly. So a key component that is the question of what temperature buildings should be and how best we should live in them. And related to that is the question of comfort and then also around that; health. So there's this idea that as buildings become too hot or too cold, they go from being simply uncomfortable to actually unhealthy. Would you be able to give the listeners a little bit of background about how comfort is determined in buildings, and what kind of factors influence how people are comfortable and things like that?

Giorgos Petrou 5:30

Sure. So there are a lot of factors that influence thermal comfort, which includes what activity you're in, might be engaged in your clothing levels, your age, and, of course, air

temperature, radiant temperature, air movement, and humidity. So it's, it's this combination of factors that can make us feel thermally uncomfortable at times either too cold or too warm. And naturally, due to metabolic processes, human body generates heat, which needs to kind of dissipate at the rate to ensure a core body temperature of about 37 degrees, right. And issues will arise when you're when the body's not able to maintain that temperature. Either because they, for example, we've been the indoor temperature is elevated, it's not able to dissipate heat, as quickly, in that case, you could do certain things, change the clothing levels, to be able to get hit faster, or naturally, the body through perspiration might be able to just deal with this additional level of heat stress, I guess. And when the heat stress levels are quite low, that's where you just might feel, you know, a bit uncomfortable, a bit warm, you might struggle to concentrate or to sleep at night. And that's often what we put under the umbrella of wellbeing can just general thermal discomfort. But if heat stress levels are quite high, or in certain cases where individuals might be vulnerable, then this can lead to more serious implications. So due to thermal extreme exhaustion, or even heat stroke, which in some cases can result in impact.

Harry Kennard 7:31

yeah, that's certainly interesting. There's, it's been my experience from sort of observing people's understanding of how to stay cool in buildings, especially in the UK, whenever there's a there's a heatwave, you'll get these tips that come out. And there are a number of things that sort of float around in the public discourse, which I think are best unhelpful and worse, potentially dangerous. In terms of things, I'm specifically thinking of the idea that I've read a few times that when it gets to a certain temperature, you don't need to put a fan on because you're just moving warm air around. And that doesn't, that doesn't impact anything, so you don't actually feel cold. While that is true. at very high temperatures. I think it's safe to say and you might correct me on this that in the UK, you're almost always going to be in a regime whereby a fan will improve your comfort, if it's too hot. Is that is that fair to say?

Giorgos Petrou 8:24

Yeah, I think I think that would be fair to say, yes, probably in most, most climates really, because through having that air movement, I you it helps you feel cooler, and increases the rate of heat loss for your body through essentially forced convection in your body.

Harry Kennard 8:46

Right, because you're essentially just evaporating sweat from your skin, right?

Giorgos Petrou 8:50

Yes, yes. And I think I'm testament to me too, to maybe about 2-degree difference on how you feel on your on your thermal comfort level. So it feels like two degrees cooler. It's actually it actually is and that's why it's you know, it's quite useful is that the issue sometimes might be in case it's really cold outside, it's really hot outside. And it's not as hot indoors, if you open the window, which again might result in that feeling of comfort just because of the air movement. It will though at the same time increase indoor temperature, because you have heat from the hotter outer environment to make cooler indoor environment. But the use of an electric cloud, for example, is not going to change. It's not going increase the indoor temperature, but will provide you with some level of comfort. So I think that can be quite an effective and relatively low energy consuming method

Harry Kennard 9:55

Exactly. There's the general idea that if you are using heat heating or cooling and buildings, it tends to be a very energy intensive activity. It says I suppose that leads us quite nicely on to my next question. So you said it'd be helpful to sort of guide the listeners through some of the key concepts around why buildings overheat? I think this is always a bit of a mystery in the UK, especially since there is this dichotomy between old buildings which tend to be large and draughty, typically, and new buildings, which tend to be much less draughty. And depending on how high up you are sometimes much more susceptible to overheating is that is that the right picture or is there was probably more complexity to that,

Giorgos Petrou 10:38

Most things are more complex than at least we want them to be. But I just, you know, looking at factors that lead to building overheating, I guess, the first one is, I would start with always location. So even within the same country, you know, typically in the Northern Hemisphere, more southern parts of the country, especially a country like the UK will tend to be warmer by nature, just air temperature, and solar radiation levels are higher. And of course, you can have the effect of living in a city compared to living in a more rural area where in cities you have the urban heat and urban heat island effect, where essentially, you have large parts built up with concrete, which not only it's quite good at absorbing heat and then bracing it, it also reduces the epic, let's just call that rolling through air flow through ventilation. Right. But then, when you look at the building designed specifically, floods have been shown to overheat more than other types also meet terrace homes, which again has something to do with floods, for example, as chilli cook for floods, you have the roof exposed to solar gains. And you also often have reduced capabilities of cooling down the building through the ventilation. Right, especially with single aspect flats where you only have one facade, Windows and only one facade.

Harry Kennard 12:24

You you can't get a cross breeze is that the idea?

Giorgos Petrou 12:27

Exactly you can't get cross inflation, which is far more effective and cooling than just single aspect. Opening source of inflation, certain factors, you know, have are quite effective, certain characteristics such as roof insulation has been shown to lead to lower indoor temperatures, because of slower heat flow rate through the roof.

Harry Kennard 12:52

Okay, it's interesting. So that might be a little counterintuitive to some people, the idea that if you insulate the house, you know, naively you might think if you insulate the house, it gets warmer, but that's not quite right. Right? Because you're really preventing the house from changing temperature. Exactly.

Giorgos Petrou 13:09

Yes. So and that's why that's why looking at the literature, there's been, you know, a few contradicting findings with regards to insulation. But I think what's probably missing there is the insulation, together with other factors, right. So if you just think of external shading, for example, so you use that to block solar gains. And those pastorates forward, if you prevent solar energy from reaching inside the house, then you are reducing the overheating risk. That's quite straightforward. But with insulation, as you said, you're reducing heat flow, which could be bought from indoor stores and from other strangers. So the thing with more modern, more insulated and airtight dwellings, is they might have a bigger potential for overheating. If certain things don't happen, for example, if you don't ventilate properly, overnight, or if you have very high internal gains,

Harry Kennard 14:11

right, besides the idea of people doing stuff in the house, that you know, if they're taking lots of baths every day, and you know, using very inefficient appliances, and

Giorgos Petrou 14:20

and Yeah, lots of you know, cooking and baking and really hot tubs. Yes, yes. So I think with regards to the insulation, it's just a bit more than humans just because it's it has to do with what other things are happening at the same time in order to make sure that there isn't a lot of heat that accumulates indoors, and then it's more difficult to escape through conduction. Right. But yeah, I wouldn't say that I'm more modern and insulated homes automatically mean more overheating. But there might be, it might be easier to get to that point. If you're not more, I guess aware of For what to be careful of. And I think that that's

also kind of a problem of having overheating issues in a country that traditionally has not been very warm. I don't think it's very clear to a lot of people on how to what to do on, you know, hot summer days compared to what to go during the winter.

Harry Kennard 15:20

Yeah, I'm thinking of, I'm thinking of the shutters that you get in, you know, nice little Italian towns. Exactly. Prevent sun coming in, and then also allow airflow, right?

Giorgos Petrou 15:32

Yes, yes. Yeah, that's correct. I mean, you can see if you look at the homes in countries that have been dealing with overheating for decades, that they there are quite a few noticeable differences compared to our homes, which have been built with the main purpose of keeping them as warm as possible. But also with regards to the knowledge of occupants on what to do, or, you know, maintain a nice warm environment during the winter, but not necessarily knowing what to do, and just summer on hot days.

Harry Kennard 16:07

That leads me very nicely on to my next question, which we touched on a little bit already, which is, what are the kinds of things we can do in the UK to prevent overheating, obviously, it'll depend, like you say, on the characteristic of the house, but they're, they're sort of some very basic steps that people can take.

Giorgos Petrou 16:23

Yes, I think, if possible, what our research has shown is that some form of external shading, so it could be just kind of an overhang or exterior shutters can be quite effective, especially on very hot days to block tan from sunlight from coming in, and reduce solar gains. Of course, if you're living in that top floor flat or with an insulated roof, and properly insulating the roof would have a beneficial effect, there are certain things we can actually do that are not going to require any cost or too much time. But it's, it's more like smaller behavioural stuff, such as on holidays, for example, you try and really meet the cooking and baking, you might do. So try and limit the internal gains have something more refreshing like a salad, you find the use of certain appliances, and every important part is to ensure if possible, that you ventilate well, especially overnight, when it tends to be quite a lot cooler outside. So you have another bigger effect. There are other, I guess, more costly things you can do, just improving increasing thermal mass, but that can be quite difficult, which has a dampening effect on indoor temperature. So it tends to result in lower peak temperatures during the day. It might result in slightly higher temperatures overnight, but when accompanied with

night-time ventilation, can have a rather beneficial effect. But of course, increasing thermal mass would be a rather big change to building. So it would be quite

Harry Kennard 18:20

the example there maybe as I put into my own upbringing, I grew up in a very draughty farmhouse in Wales, which the thermal mass is probably extraordinary because the walls were sort of three foot thick, and I made a very heavy stone. And as a result, in the in the summer, if it was, if it was, I mean, never got very warm in Wales, I could always, but if it was sort of 25 even 30 degrees outside, you'd go in the house, and it would be kind of like an icebox. So and it will just stay that temperature most of the year. So that's the that's the idea where it is quite hard to change that aspect of your house if your house isn't made if Yeah, three foot thick stone, then, you know, good luck making that change.

Giorgos Petrou 19:07

yeah, that's a that's a factor that we've kind of known for a while it can be quite beneficial, but at the same time, it's just easier and cheaper to construct homes being more with more lightweight constructions at the moment, right? So that's why they're one of those guys, they're on the rise. You can still make lead with homes to be very well insulated. Yes. Which ident can be quite beneficial provided you at the same time ensure that you know you ventilate well and you may meet solar gains during hot days. I mean that's, that's, you know, one of the worst combinations you might have is very high placing levels in rooms facing west or southwest and then at the same time being very airtight and Very well insulated, because you will have a lot of heat transfer from outdoors through the windows, which you're not going to be able to dissipate very easily.

Harry Kennard 20:09

Right? Yeah, that's I mean, that's precisely how you design a greenhouse, right?

Giorgos Petrou 20:14

Yeah. And there have been, I think, a few cases where they've also designed homes like that.

Harry Kennard 20:21

That's unfortunate. So just moving on to the last question here, which is we're putting out this podcast in the context of COP 26, which is happening in Glasgow. And I've been asking everyone what message they would like to get to the world leaders who are attending the conference about how to deal with this issue in the context of climate change. Do you have any thoughts in that regard?

Giorgos Petrou 20:44

I mean, it's great that Alaska is hosting cop six. And I'm looking forward to the outcomes of that, I guess, a message that comes to my mind is that it's very important to deal with climate change mitigation. And at the same time, I think we need to be spending as much effort on climate change adaptation in order to protect health and wellbeing, because we are looking at already an increase of about 1.2 degrees from preindustrial levels. And with our best efforts, we might get to my limit at 1.5 degrees. But it's still unlikely that it goes beyond that. And 1.2 degrees has already led to increase the frequency and severity of heat waves, wildfires, and flooding. Hence, adaptation has to be part of what we're doing. And it has to be, you know, led by the governments and at the same time, public message has to go out to people to realise that climate change is not something that's just happening in the future, and we need to prevent it. It's already happening to us; we need to make sure we are able to deal with the consequences.

Harry Kennard 21:57

Excellent. Thank you very much. That's an excellent answer. Thank you very much for joining me on the podcast. I do hope your work is a success, and that we don't have a hotter future than we can bear. Thanks very much for joining.

Giorgos Petrou 22:12

Thank you.

Harry Kennard 22:24

You've been listening to the Climate Change and Health podcast that was Giorgos Petrou from UCL. If you'd like to get in touch with any questions, please do so at Twitter @HarryKennard. A final thanks to Kevin MacLeod who wrote the music which appeared in this podcast. I found it on free pd.com thanks very much for listening.