

Hormones: The Inside Story

Episode 5 – Is modern life overloading our stress levels?

This is Hormones: The Inside Story, the podcast brought to you from the Society for Endocrinology, looking at the tiny things pulling the strings inside your body. I'm Georgia Mills.

This episode: It's with us every day of our lives to a greater or lesser extent - we're certainly talking about a lot during 2020. It's been blamed as the cause of heart disease, strokes, weight gain and declining mental health. But it's also an incredibly slippery concept that has been misrepresented and mischaracterized. Yes - it's stress. Stress is talked about a lot. Usually in terms of how stressed we all are, and how to deal with it.

So is modern life overloading our stress levels, and what are stress hormones actually doing? Well, this episode aims to find out - I'll be meeting scientists who study stress, and also someone who experiences stress to a much greater degree than most of us...

CLIP - What happens is, I instantly get the feelings and the emotions that I felt in that moment just come back to me

...and finding out how hormone science might be able to help people like him in the future.

So before we get too relaxed - what is stress?

Stafford - Stress is basically the perception of a person or an animal that he or she is under threat.

Introducing Stafford Lightman, professor of medicine at Bristol University.

Stafford - It might be a real threat. So it might be a lion charging towards you on the savannah, which is obviously a real threat. Or it might be something that you're really anxious and worried about, which might not actually be happening but it's something that you perceive that is a threat to you.

It can be the stress of relationships, work - money. It looks different for different people, meaning studying stress is kind of hard.

Stafford - It's absolutely not a scientific term. One of the biggest problems in stress research is the word stress because it means different things to different people. It is not something you can easily quantify.

Some people will find a particular situation stressful, which others won't find stressful. So one can't define stress as a particular situation. It is the way that individual interprets that particular situation. So I actually quite like talking in front of lots of people, whereas certainly I know lots of people who would absolutely dread it.

So can we actually say that we're more stressed now than say, fifty years ago?

Stafford - The people who say they feel stress, it may just simply be that they're unhappy.

People think they're living in the most stressed time society has ever had and they talk about, you know, the stressed society and how difficult it is.

But there is no way we can say that we are more or less stressed as a population than we were 10, 20, 30 years ago, because there is no... one: there's no definition of what being stressed is from an objective point of view. And two: there's no way of measuring it hormone-wise so it is extraordinarily difficult to study in humans.

So the idea of stress is something that we all are really familiar with but not everything we read about it is based in science... Importantly, while almost all the discourse we hear about stress is that it's bad, Stafford doesn't agree.

Stafford - This is clearly of enormous survival value and it's very important to have a good stress response mechanism.

So why is stress so useful? Well let's go through what actually happens in a stressful situation. Picture the scene: you're wondering down the road, and suddenly you see it - a great big tiger heading your way.

Stafford - The first thing that happens is that you stimulate your sympathetic nervous system. This is a very rapid response.

This is the part of your nervous system we don't have conscious control over - things like heart rate and sweat glands.

Stafford - This releases noradrenaline at the terminals of the sympathetic nervous system that also adrenaline from the adrenal gland. So this is a classical fight and flight response. That's the first active hormonal response.

High heart rate, sweaty palms, your body becomes a springboard ready to leap into action - pumping blood to your muscles and cooling you down.

Stafford - The second response, which is a little more delayed, which is probably delayed about 50 minutes or so. Is that your brain basically activates your pituitary gland to release the hormone ACTH.

The pituitary gland is a little bean shaped area in our brain, it sits a little way behind our nose - and the hormone it releases ACTH - causes the release of probably the most famous stress hormone.

Stafford - The hormone cortisol, which goes around blood and has effects in all the different organs. So most all the different organs in the body. So it has effects on your cognition. So it helps from brain function.

Allowing you to focus on the problem at hand, spotting a good hiding place from this rampaging tiger, instead of what you're going to have for dinner.

Stafford - It also releases sugar from your liver. You need your blood sugar to go up, to give your skin, to allow your muscles to have the energy to run away. It's adaptive. It's extremely important. It's extremely good for you.

So your system is flooded with sugar in the form of glucose. This is biological Lucozade, giving your muscles enough energy to stay in full on maximum overdrive and leg it to safety.

Stafford - So all of those things, you have the rapid, rapid effects from the adrenaline and then the rather slower and more prolonged effects from the adrenal steroids like cortisol.

This is an old system, and it's very important - I know we don't encounter tigers so often - but there are still risks out there like this. And even in our mundane stresses of deadlines and performances - this system can be useful. Take the example of the violinists.

Stafford - Yes, I mean, it's one of these things that people always say "oh stress is bad for you. And, you know, if we could alleviate your stress, life would be so much better". Musicians thought, oh, you get up on stage, you stand up with these hundreds of people watching you and you're clearly extremely nervous. If only you could get over those stage nerves, surely you could play better. And the evidence was that people have treated these people with agents which would reduce their perceived stress levels, and actually they play much worse. There's not the excitement, they don't actually put into it all the brain function, which they could do normally. So actually, they play much better when they're stressed. Actually, being stressed can heighten your cognitive ability to do all sorts of things. So stress, even in our society, in this respect, is actually good for you and not bad for you.

So stress gets a bad rap, we need it to survive, and do our best in testy situations. BUT, the stress we've been talking about is what we call acute stress. A quick response enabling us to deal with a crisis. What if that same tiger is chasing you for days, popping out from behind every bush to give you a scare? Or - you have a very stressful job. Or ongoing relationship breakdown. Then that acute stress becomes chronic

Anne - Certainly chronic stress is bad for you.

This is Anne White. Professor of Endocrinology at the University of Manchester. She looks at a feedback loop in the brain and body that affects the stress response.

Anne - The access that I'm talking about is called the hypothalamic pituitary adrenal axis or the HPA axis...

Georgia - Snappy name!

Anne- Yeah. We all know and love it.

The HPA axis is a series of feedback loops in the body involving several hormones.

Anne - You can see how complex the regulation of the release of cortisol is in the sense that we have two other hormones whose really main function is just to regulate the release of cortisol and then cortisol feeds back and switches those hormones off, which then dampens down its own release. And so that's very carefully regulated.

The stuff that is very useful short term can become problematic if it's used again and again and again. Take the biological Lucozade!

Anne - Well, chronic stress can be dangerous in that if you chronically activate the HPA axis and the release of adrenaline you are likely to have higher glucose circulating. And that can lead to type two diabetes. You are more likely to put on weight and become obese. And it can have effects on your cardiovascular system, because if you think about increasing your blood pressure when you have an acute stress, but if that's happening all the time, you end up with high blood pressure or problems with the heart. So yeah, chronic stress is tricky. And it's difficult to define what each of us think of as chronic stress because some of us thrive on stress whereas other people find it hard to cope with.

Stress hormones clearly have a big impact on your body. But they can also have an even bigger effect on your mind. We all are aware of the unpleasant *feelings* of stress, like feeling overwhelmed, helpless or generally strung out, and again - chronically this is associated with anxiety, depression and burnout. But those hormones can also affect another fundamental part of our brains. And that can cause a big problem.

Vanessa - we are looking at how stress affects memory

This is Vanessa Hennessey, she's a research graduate student at UCL. And if you're now thinking that stress causes you to forget things - it actually has the opposite effect.

Vanessa - You know, if you've survived an encounter with a tiger, it's a probably good idea that you can remember how you got out of that situation in case it or a similar situation occurs again.

So having the fact that stress heightens your memory, you know, it's an adaptive feature.

It makes sense that we don't forget how we escaped stressful situations, so we can do it again if we encounter the same thing in the future, or even avoid it altogether. And this is thanks to those stress hormones.

Vanessa - This leads to sort of a sort of hyper alertness in certain parts of the brain, which have receptors for cortisol.

And these are the hippocampus and the amygdala and a few other brain regions which have a high density of these receptors. And this leads to hyper storage of these adverse memories.

So the complex interplay of the stress hormones in our brains leads to the memory of the stressful event being laid down really strongly.

Vanessa - Now, if all is well, then these memories should be ultimately consolidated, stored in an appropriate way, i.e. they are incorporated into your life history so that it's incorporated with the context it happened. You can make sense of it, that kind of thing.

But again, if you're chronically stressed, this goes from being adaptive and useful to bad news. This can kind of overload some parts of your brain, and the memory centre can actually shrink.

Vanessa - So it's like a vicious circle because of course, then that means you're on hyper alert and you fight more things that are threatening and the chronic stress continues. And this has an impact on the hippocampus, which is very involved in memory where, in chronic stress, people suffering from chronic stress, you can actually see a reduction in the volume, the size of the hippocampus because you're seeing neuron damage and not enough new neuron connections being made.

But that's not all. In some situations, this hyper acute memory doesn't get filed away properly.

Vanessa - What makes it different when it becomes a psychological disorder is the fact that it has the memory of this has not been properly incorporated with all your other memories, your autobiographical memory. So it often loses its sense of context and within the rest of your life's memories and it stands alone and is just this raw emotional quality.

This out of context memory can cause lifelong problems for people with the condition. It's called PTSD.

Willard - Hell, I'm Willard Foxtan and I am a journalist, and I used to be a war reporter back in the day.

I used to joke that essentially it meant a permanent holiday pass to the axis of evil back in the mid-2000s. So I used to go basically to any country that was on fire and hang around in a flak jacket, just sort of trying to explain what was going on.

Unsurprisingly, being a war reporter means you're no stranger to stress.

Willard - It is rough. And it obviously, you know, it plays on you. It plays on your mind. And you see awful things and awful things and you've got no power to do anything about it.

But while these awful events happened regularly, there was one that changed his life.

Willard - It was covering the Israel Lebanon war in 2006. And essentially I was up right in the front line and I was involved in what was a battle. There is a Wikipedia page which describes it as the battle of Wadi Saluki. So it wasn't like a skirmish or a firefight. It was a proper battle. I got caught up in the middle of it.

And I was taking shelter under an armoured vehicle and it got hit and it burned.

I saw quite a lot of people die at close range, but I saw one person in particular die very close, very, very close to me.

I didn't immediately break down at all. It was okay. Finally when I got back to England and, you know, I was still out there for like four more weeks after some of this stuff happened. And then I came back and it was gradual, quite gradual over about six months, whereby I, you know, I was tired all the time. And I found it very difficult to relax, I found it very difficult to sleep. And when I did sleep, I would start having, you know, very, very disturbing dreams. Not all the time, but enough that I noticed. I would have disturbing and upsetting dreams.

The first few times I got triggered it was really traumatic, really, really traumatic. And I became really concerned I would break down in public and, you know, sort of British, you don't want to be like really to kind of a reduced to a crying wreck in the middle of a shopping centre or a bus or anything like that, because it's really - it sounds so pathetic to say but it's really embarrassing.

When you have PTSD, something can trigger the intrusive memory. This can be something related to the incident, a sound, a smell or an object, it can even be something as seemingly inoffensive as a colour.

Willard - A very difficult trigger of mine after that burning tank experience is if I hear a diesel engine idling. So, you know, when you're sort of sat on a bus, it stops at a traffic light and you are sat at the back of the bus and you hear the diesel engine going 'thump thump thump'. Or, for example, as is often the case triggering me, when an Ocado van parks outside your house. And as long as it's a diesel engine and it's running, it can - it's much less than it used to - but it can take me right back into that moment.

And this isn't usually the Hollywood style visual playback of the event. It can be much more visceral.

Willard - I will not like, see the thing that happened to me in front of my eyes or hear the things that I could hear at the time. What happens is, I instantly get the feelings and the emotions that I felt in that moment just come back to me. And it is absolutely like an overpowering wave of, like, fear and horror and revulsion and disgust at myself and upset. And it just, it's almost incapacitating. I've got to the point now where after quite a lot of therapy treatment, like if I am triggered, if I do have an incident like that, like, a kind of a half an hour sit down and then like a little walk around the block, in like cooler air will like sort me out. I just won't go on buses really. Because a diesel engine turning over quite close, it does genuinely upset me, which is so weird. Like even saying it, even after years of living with that, it's weird, it's odd that I can't handle a diesel engine turning over, but that's just what it's like.

Vanessa is working on treatments for PTSD, funded by the Bobby Charlton foundation, whose primary focus is on the problem of landmines. But it's not just battles and weapons of war that can cause PTSD, car crashes, assault, theft - even childbirth. PTSD can crop up a lot.

Vanessa - the prevalence worldwide of around five to seven percent. But then in some populations where there's repeated trauma and lot of conflict, like in refugee populations, there can be up to 70 percent prevalence.

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There are therapies which can help with the symptoms of PTSD, but wouldn't it be nice if we could try and prevent it in the first place. And this is where we come full circle, back to our stress hormones. Because cortisol is so important in laying down these memories.

Vanessa - So it does seem to be something to do with the relative levels of cortisol to other hormones and also the timing relative to the trauma.

Vanessa and her team had a theory - if they could moderate the levels of cortisol after a traumatic event, maybe with a drug, this might stop the PTSD from developing. There's just one problem - how do you test a treatment for PTSD, without giving your test participants actual trauma? It turns out you go to Hollywood!

Vanessa - We show them a film. And this film is a highly distressing film. It has graphic scenes. We warn them before, but it does have scenes of interpersonal violence, death, sexual assault, that's kind of thing. It's a 50 minute long film. They watch that, and then we give half of our participants in this study hydrocortisone tablets. The other half get placebo.

Hydrocortisone is a medicinal form of cortisol, it's already given to people who don't naturally make enough. Vanessa can then ask people who saw this gory film how many intrusive memories surface in the following days and compare people who took it with those who didn't.

Vanessa - Hydrocortisone did really show a significant reduction in frequency of interesting memories in the first few days after the film compared to those who got placebo.

Less nightmarish visions from the film. It's promising, but does need replicating, Vanessa's first study was only in women on birth control - strangely enough because menstrual cycles seem to strongly affect the prevalence of PTSD, and she's still collecting data, but they are hopeful - if it does really work first responders could administer this to people after accidents or crimes, and maybe catch some people in time.

Vanessa - Any preventative measure will have to occur really quite soon after the trauma. That's because of the way memory works. So probably it will need to be within a maximum of six hours and definitely before you go to sleep. So one of the reasons that we need to find out exactly which treatment works for who best is because there's not going to be any room for trial or error. So if somebody had some sort of trauma and they go to some form of medical centre, if they know this works in this situation, then they can be given it.

So ironically, a stress hormone could have a beneficial effect on reducing the worst kind of stress outcomes, but it's still early days and her work is ongoing.

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So stress hormones can be extremely useful, in treatments, and in helping us respond to stressful events. But they can cause us problems. So do our stress expert guests have any advice on how to try and mo

And while PTSD isn't as rare we might think, it's still not nearly as common as the stress many of us feel in our daily lives. But the good news there is that there are lots of ways to reduce stress. So I asked each guest what they thought.

Vanessa suggests exercise is an important coping mechanism.

Vanessa - There is good evidence to suggest that, you know, obviously, just like with any physical and mental health, is sort of a good, good lifestyle helps, but particularly this interesting research done on moderate exercise, which doesn't seem to be just good for cardiovascular health, but seems to prime receptor system called the governor object system does seem to have an impact on stress and

also seems to change the behavioural response to stress. This was carried out in rodents, but they used focussed very much on voluntary exercise rather than forced exercise. So I think possibly the take home message is also do an exercise that you enjoy and also doing just for the sake of it. And obviously don't do it to excess because excess exercise is also quite a stressor. But just don't be sedentary. I think also there's quite a lot of very interesting research because sleep is so important in consolidation of memory and so improving exercise also improves your sleep patterns and sleep is different. Cycles of sleep are very important to try to sort of keep to his regular sleep pattern as possible. That helps reduce stress in general.

Georgia - I like the advice about not doing exercise we don't like. That's most of it at the moment.

Vanessa - Well, exactly.

Contact is also important, with other people or with animals - Anne White's new puppy is certainly moderating her stress.

Anne - Because when you stare into those liquid eyes and you sit cutlery, it is like having a very big or very small teddy bear. But on the other hand, trying to stop her chewing my computer leads and my shoes has stressed me no end.

While Stafford suggests that anything you think might help, probably will, but that we should keep a sceptical view of magic de-stress cures that claim to be 'proven to reduce stress'.

Stafford - When one says the science behind it. If you're looking for measurable hormonal or other levels like this, there's a bit. But it's not terribly strong because it's so difficult to study, because in order to study it, you need to have a proper control group. And that is incredibly difficult to do in this particular situation. Having said that, I'm quite sure that a lot of these yoga things can be very helpful and the person will know whether they're being helped or not. And if an individual feels better and feels they can cope better when they've had a course of yoga or whatever it might be, then that's great. But I would be perfectly happy with that individual's reporting back that they feel better and they're able to cope. So that's a bit that matters. But if you ask for objective indices of reducing stress, the evidence isn't good. There's a little bit. But it's pretty airy fairy.

So basically, do what works for you. If colouring in or meditation make you feel better - great. Or try some exercise - just try and find one you enjoy! But the big takeaway is that while stress can be a problem, if it overloads and causes PTSD, or it's chronic, putting pressure on our systems, in general a little bit of stress is a good thing. It helps us survive through the complicated action of cortisol and adrenaline, gives us the mojo to blast through a deadline, or even just the energy burst we need to run for that bus. And if you have particularly bad luck, it'll give you a better shot at escaping a tiger.

Thanks to Vanessa Hennessey, Willard Foxton, Anne White and Stafford Lightman for their help this episode.

Next time - for the last episode in the series - we're not going to look at hormones themselves, but at the chemicals all around us that can mess around with them. How dangerous are endocrine disruptors, really, and how can we escape them?

You and Your Hormones is a podcast from the Society for Endocrinology. You can find reams of information about hormones at yourhormones.info, you can follow them on twitter @soc_endo or find them online at endocrinology.org

This show was put together by me, Georgia Mills. Kat Arney is the executive producer and it was made by FIRST CREATE THE MEDIA. Till next time!