Transcript

Danny Lennon: Here we are. A big welcome to the podcast, to Dr. Austin Robinson. How are you today?

Austin Robinson: I'm doing great, Danny. How are you?

Danny Lennon: I'm doing very well and I'm very excited for our conversation today. Not only because I found a number of your publications that I've been reading quite interesting, but I think regulators will know this issue around blood pressure and then more generally, cardiovascular disease is a big interest of mine and a number of these elements, particularly how it relates to sodium within the diet, but then even beyond blood pressure and hypertension more broadly are fascinating topics to consider. And there's many of the interesting nuances to this that I think your work has been particularly good at highlighting. But before we get to any of that, just for people listening, can you maybe give an introduction to yourself the type of work you're doing, your background academically and that your current focus in academia?

Austin Robinson: Sure. Well, first off, I just wanted to say thanks for having me on. I know my friend Jake Mey was on the podcast a while back and vet people like Stu Phillips and Kevin Klatt on recently, just people that I really

respect their work and what they're doing as well. So I'm pretty excited for this.

Now regarding my background I started out actually at a really small school in Michigan called Kalamazoo College. And I went there to play football throughout middle school, high school. I always was into sports. I liked football, basketball. I wrestled for a year. So I, it was a small school and I went there to play football and I was a microeconomics major.

And at the time I started out thinking maybe I would be a business major and potentially open a gym. And then just didn't have a great experience there. So I ended up transferring to another small school in Indiana where I'm originally from called the University of Indianapolis. And I was an exercise science major and really just of fell in love with school for the first time at that point.

So I always viewed school as something I had to do so I could play sports. And once I got into exercise science, that really just changed my perspective. I really enjoyed taking classes like anatomy and physiology and some, even some of the chemistry courses. So towards the end of my degree, I knew that I wanted to do, something more than.

Be a personal trainer or a strengthened conditioning coach. I knew I wanted to continue to like, take classes and challenge myself and learn more about human physiology. So at that point I decided I would pursue a master's degree. And so I did my master's at the University of Illinois at Chicago.

And while I was there, I really got into research for the first time. So in undergrad I had been really briefly exposed to research, but again, it was a small liberal arts school, whereas at University of Illinois, Chicago, there's just really active research environ. So the first studies I helped out with were basically on critical power and kind of sub elite cyclist.

And it was interesting. I liked it, but it wasn't a question that I was, super passionate about. And then again, towards the end of my masters I was thinking, Okay, I want to keep going not sure what I want to do next, but I knew some of the career options that were available to me just weren't as appealing.

So I started looking into PhD programs and during the second year, my master's, I started working with a lab that was doing some work with resistance training and vascular endothelial function. So that was Dr. Shane Phillips lab and I ended up sticking around in that lab for my PhD. So we did a lot of work with acute resistance exercise and how that can influence endothelial function in individuals with obesity.

And so that kind of combined a lot of things that I was passionate about. I had a family history of cardiovascular disease. Even as a teenager, I had hypertension and endothelial function was somewhat new to me at the time. So, learning about not only nitric oxide, but all these other pathways of vasodilation through potassium channels and hydrogen peroxide mediated vasodilation and prostacyclins, it was just like a whole new world for me and gave me a lot to think about and to study.

So I stuck around in that lab. And investigated an epithelial function for the next three, four years. And then towards the end of my time at UIC when I was looking for posts, I had multiple people refer me to Dr. Bill Farquhar' s post opening. So he is professor at the University of Delaware. And so I went to visit a few postdoc labs, and that was the lab that I liked the most.

I thought they had a good team in place. There was a lot of resources. They had just moved into a new building and Dr. Farquhar was really gracious, like when I came to interview, just seemed really friendly and like really eager to have me join the team. And they were doing work on salt resistant individuals and vascular function.

So that was new to me at the time. The whole salt resistant versus salt sensitive. And we'll talk about that during this podcast, I'm sure. But basically when people refer to salt sensitivity, they're referring to resting blood pressure. So if you take one group of people and give them a high salt diet and their blood pressure increases and then you give them a low salt diet and their blood pressure decreases, they would be considered salt sensitive, meaning their blood pressure changes with changes in sodium intake.

And most individuals are actually salt resistant. So if you take your average 25 year old and give them a high salt diet, their blood pressure doesn't change. And so they might think, Oh, I'm fine. I'm young, I'm healthy. It doesn't matter how much sodium I take in. But in reality, they may be

experiencing things like a reduction in vascular endothelial function or a acute, not really clinical level, but some kidney injury if they're continuously taking in high sodium meals. So there's some negative physiological changes that could be occurring even if your blood pressure isn't changing. So that was a new concept to me and I joined the lab and helped out on a controlled feeding study where that was what we were interested in, the effects of salt on sympathetic outflow and blood pressure regulation and individuals with and without salt sensitivity.

And from there again, we had a pretty good group in the lab. There were three PhD students in myself. We also had a study coordinator and Dr. Farquhar. So we started coming up with side projects that we could do to expand upon the big study that was funding our lab. So we did some work with acute sodium then we did some work with salt capsules.

It's just a cheaper way to manipulate dietary sodium, and that enabled us to do some exercise studies that we couldn't do. In the primary study in the lab because we are performing a technique called microneurography. So with this technique, you basically place a really small needle. It's basically like an acupuncture needle it's tongues and electrode, and you can record post ganglionic sympathetic nephonic activity.

And it's a very cool technique because you're basically assessing sympathetic outflow in humans. But one of the caveats is you can't move at all once you obtain a nice recording. So that limits your ability to do things like full body exercise. So we did some studies without microneurography and salt loading.

And then again, towards the end of my postdoc, I applied for a career development award through the National Institutes of Health that was focused on potential racial differences in salt induced vascular dysfunction and changes in sympathetic outflow. And the reason I was interested in that is because there are several studies out there demonstrating that in America black adults are more likely to experience salt sensitive blood pressure than white adults, but the mechanisms aren't really well understood.

So I wanted to look at things like what's, what's changing with vascular function? What's changing with sympathetic outflow and autonomic control of blood pressure, but then also social determinants? So, I of grew up in just a regular blue collar town. Pretty diverse. Middle school, high school,

elementary school, things like that. So I felt like as somebody who grew up in that environment and someone who's biracial, I was like, I bet there's a lot of social determinants here that haven't really been appreciated in some of the past literature. because as in physiology studies it's usually, you observe something, some physiological characteristic in two groups or three groups or whatever, and it might be cross-sectional or there might be an intervention, but there's usually not much of an emphasis on things like socioeconomic status or perceived stress or racism or physical activity or cardio respiratory fitness.

So there's all these other things that I think, could contribute to some of these racial disparities that we see in salt sensitivity. And so that's one of the things that I'm trying to study now with this career development award. And I took that award with me to Auburn University in Alabama.

And so I started here three years ago. I'm in my fourth year now as a faculty member. And so that's where I'm at now.

Danny Lennon: Just so everyone is maybe refreshed on the topic of sodium and blood pressure and why they're commonly talked about together and to get us at a good starting point.

What do we, from a population level as a very average, how do we typically view that relationship between sodium and blood pressure? And why is it that they are so, tightly linked when we're talking about the topic of BP?

Austin Robinson: Sure. So going back to, let's just say the seventies, late sixties folks like Jeremiah Stamler, there's kinda these observational studies showing that populations that eat.

Kind of a traditional diet, less processed, less salt on average tend to have less blood or less high blood pressure or lower blood pressure compared to populations that had adopted a more westernized diet that, there's more than just sodium there. There's also more refined carbohydrate and added fat and things of that nature.

So just broadly speaking, a relatively unprocessed diet compared to a more processed diet is associated with lower blood pressure. And then one of the things that was hypothesized to be playing a role in that was dietary sodium.

So there have been other studies that specifically focused on sodium intake and blood pressure, and consistently showed that higher sodium intake is associated with higher blood pressure.

Thinking, not as far back as the seventies, but let's just say like the late nineties, early two thousands, we had the DASH sodium study. So that's the dietary approaches to stop hypertension is what DASH stands for. And so one of the studies is DASH sodium. And so for this particular study, there were four week diets where participants underwent a low sodium diet, a recommended moderate sodium in a high sodium diet, and they ate these diets in the context of the dash diet, which is fairly agreed.

Most people would agree. It's relatively helpful, at least compared to a standard American diet. So it has whole grains, low fat, dairy fruits and vegetables, and then they had the high sodium, medium sodium, and low sodium in the context of just a standard. And so what they found in this particular study kind of flagship study or paper was led by Dr. Frank Sacks. But in that study, whether you were on the dash diet or the standard diet, there was this dose response where blood pressure increase from low to medium to high, and then on the dash diet, it's a healthier diet. So blood pressure was lower at each given sodium intake compared to the standard diet.

So even though background diet was important, And eating a healthier diet is gonna result in, better cardiovascular health and lower blood pressure. There's still this role of sodium leading to increase in blood pressure. And then there's just these population level studies where they've tracked, 24 hour recalls and looked at sodium intake.

Things like NHANES for example. And again, if you look at the whole population, those eating the highest sodium are going to have the highest blood pressure on average. So there's plenty of data at the population level suggesting that sodium is linked to blood pressure. But as I briefly alluded to earlier, there is a lot of individual variability.

So if you take a thousand people and on average they're eating a higher sodium diet than another group of a thousand people, they're probably gonna have a higher blood pressure. But that's not to say that everyone in

that group is gonna have higher blood pressure. Certain groups are at higher risk for salt sensitive blood pressure.

So that would include. Individuals who are older, if we think about a group that's, let's just say 60 or older, compared to people who are young adults or in middle middle adulthood, and then individuals with hypertension cardiovascular disease, comorbidities, chronic kidney disease there.

So there are certain predisposing risk factors. And then again, just on average, black individuals, at least in the United States, tend to be more salt sensitive than white individuals.

Danny Lennon: So maybe let's start working through some of those differences in a bit more detail. So already you've outlined this concept of salt sensitivity and that we can have people who are salt sensitive or any other who are salt resistant.

With this salt resistant individual being someone that even with a high sodium intake their blood pressure doesn't really budge in relation then to salt sensitivity, is that best viewed as a then a spectrum there of that. Someone can be salt sensitive, but there are varying degrees of that based on how high their blood pressure goes.

What way do we typically classify that? Are there set cutoff binds? What's the terminology or classification that is most commonly used?

Austin Robinson: Sure. And so you made a great point there. If you do give a large group of people high salt diet or if you were reduced their sodium from kind of standard diet to a low sodium diet and blood pressure changes, it follows a pretty kind of classic bell shaped distribution.

So you're gonna have some people whose blood pressure doesn't really change at all. Some people whose change, some people will change it. One or two millimeters of mercury. Most people will change somewhere between like 2, 3, 4. And then you're gonna have those kind of extreme responders who have changes of 6, 7, 8, 10, even more millimeters in mercury.

And then on the way back down, again, some even more extreme responders, but there's gonna be less of them people, changing 15 millimeters of mercury

or something like that. So the kind of, there is a universal agreement. The AHA has a scientific statement, I think that was published in 2016 where they do a deep dive into salt sensitivity su suspected mechanisms and things like that.

And again, there's not a universal agreement, but what our group at the, at Bill Farquhar, Dave Edwards, people at the University of Delaware and some others in the field have defined as **salt sensitivity is a change in mean arterial pressure five millimeters of mercury or greater**. So mean arterial pressure, classical calculation is one third systolic pressure plus two thirds diastolic pressure. So it's gonna be a little bit more dependent on the diastolic pressure, but usually with salt sensitive blood pressure it's more dependent on systolic pressure. So when you increase sodium intake, at least short term, which a lot of our studies are, there's, anywhere between like seven days and two weeks, you're going to increase thirst and increase plasma volume to offset changes in plasma sodium.

And so with that increase in plasma volume, that's gonna result in an increase in cardiac output. Or it's going to result in no change in cardiac output, but potentially an increase in total peripheral resistance. But usually what we see is lack of a compensation. So like no change in total peripheral resistance and more of an increase in cardiac output, which then leads to greater systolic pressure.

So for example, when we go back and just look at the data from some of our studies and we look at changes in blood pressure across multiple individuals and in a cohort, a lot of times what we see is more of a change in systolic pressure as opposed to Diastolic. But for the kind of cutoff, what most groups have used has been that change in mean arterial pressure of five millimeters of mercury.

Danny Lennon: Awesome. Thank you. So one of the things that comes to mind is that when we're trying to assess sodium intake and therefore a change that someone may have in their sodium intake one of. I suppose great things from a research perspective is that how tightly that correlates with sodium excretion, which is why it's commonly used in a research setting.

So we can get a really good idea of someone's sodium intake based on that sodium excretion. So that makes sense of why we'd be able to then use that

to classify whether a certain individual may be salt sensitive or salt resistant. But that clearly then leads to maybe some challenges when people are thinking of this in practice, whether that's either certainly for an individual, but that then even I'm thinking of like clinical practice for dieticians or doctors listening and thinking, Okay, this is a really interesting concept that might be useful to know about salt sensitivity and or if someone is salt resistant.

But is there, is that something that can even be really looked at in a day to day practice like that? Or at the moment, are we still talking about. That we need actually the high quality data collection that comes from a research setting to be able to actually classify someone as one or the other.

Austin Robinson: Yeah, that's a really good question.

And it takes us to the kind of logistical challenges of assessing salt sensitivity. So there are some small, physiology papers that have tried to use different tools to predict who salt sensitive. So a lot of these studies were done in like the seventies, eighties, early nineties where they would infuse people with hypertonic saline.

So that's just a quick way to elevate plasma sodium, increase plasma volume, and track acute changes in blood pressure. And then you can also give people diuretics to lead to Kind of dehydration, reduction in plasma volume and see who is most likely to experience a reduction in blood pressure in that context.

But again, these were kind of small studies. Difficult to even still, like that would be difficult for a dietician or a standard physician primary care provider to infuse someone with, hypertonic saline or give them an isosmotic, diuretic. So that's a challenge. What we would typically do in our studies and what most people do is a 24 hour urine collection.

So if you come in and we're providing you a diet towards the end of that diet, or we might even have you do multiple 24 hour collections we're able to basically take that 24 hour year end sample, mix an aqua of that. Determine the concentration of the electrolytes in the urine and then multiply that out by the provided volume that you've provided.

And then from there we can calculate 24 hour electrolyte excretion. And we're typically, most interested in sodium when we're trying to sodium intake or sodium chide intake. But again, the challenge with that is we're having to provide someone a diet for seven days or 14 days or an instance, or in the instance of the dash study I mentioned that was four weeks.

So that's obviously challenging too. But that's the gold standard is to get a 24 hour yearend collection. And then if you wanna get even more granular, there's more recent data suggesting that to get really reliable data, you would need multiple 24 hour collections. Because let's say you and I are both in a study and for one, One aim of, or one arm of the study we're taking in, a thousand milligrams of sodium.

And then for another arm of this study, we're taking in 7,000 milligrams of sodium. If we collect our urine for 24 hours every day that we're on that 1000 milligram arm of the study, that our sodium excretion isn't gonna be exactly a thousand. It might vary depending on if we exercise or our stress levels depending on if we got enough sleep, if we have a lot of cortisol and circulation.

So there's a lot of things that influence sodium excretion. And obviously your dietary intake is huge, but there's all these other factors that play a role too. So to really. An accurate sodium excretion that's reflective of the person's habitual diet or the diet that they're on at that time, you would need even multiple days.

The best that most of us can really do is that one 24-hour collection. Cause it is a burden on participants they have to carry around. Usually for most people this is more than enough, but we give 'em a 3,500 milliliter or 3.5 liter container and then we have them carry that around in a backpack. So it's a little more conspicuous and people don't see what they're carrying around.

But it's still a burden, especially for female participants. They have to use like urine funnels and things like that. So, that 24 hour sample is the gold standard. But a lot of studies, especially the larger studies, and there is some controversy that's been a result from this, use a spot sample.

So they'll have participants, after their first morning void provide a sample. And then there are these equations that have been used over the years to

estimate 24 hour excretion based on that sample. And the problem is if you use the estimated sodium excretion from this one spot sample and you use that to try to predict things like future cardiovascular mortality basically what's happened is there's been this evidence of a J curve where estimated sodium intake on the high end is associated with increased mortality, but then on the low end it's also associated with increased mortality based on these spot samples.

And so that led to a lot of controversy for a few years where there were some researchers in the field claiming that, reducing sodium too low could also be problematic and that recommendations could be harmful. because in some of these studies, the increased risks started at, or even higher than 2300 milligrams.

And 2300 milligrams of sodium is the standard recommendation for the dietary guidelines for Americans. I think in the UK it's even 2000 milligrams. And then here in the United States the American Heart Association recommends no more than 1500 milligrams for optimal cardiovascular health. Or if you're someone who's predisposed to higher cardiovascular disease risk, such as someone with hypertension.

So anyways, that led to some controversy for a while. And then more recently there's been a couple studies that have come out and tried to address that. So in 2019 Fang He and Nancy Cook and others use samples from a big study called the Trials of Hypertension Prevention or T O H P. And what they found was that if they took the 24 hour samples, so just to clarify, in this study participants did provide a 24 hour sample.

And so from that, they took the sample and they have the actual sodium excretion based on that 24 hour data. And then they used the concentration of sodium and that sample and used the estimates that are classically used. And so what they found was that when they applied the estimates, for example, one of the popular equations is Tanaka and using the different equations, they also found this J shape.

But then when they used the actual 24 hour urine excretion values that they didn't find any evidence. Of a J shape. It was just this kind of linear relation where increased sodium was associated with increased risk of cardiovascular

events over a 20 year follow up. And I mean, it did reach a plateau like once you get into like the 85th percentile or something like that.

But there's no evidence of a J shape where lower sodium intake was associated with higher risk.

Danny Lennon: Yeah. Thanks for that. That's such a crucial point for people to remember that because that is something that people will commonly come across because like you said, it was round for quite a while, this idea of this J shaped curve.

But then when you can have that accounted for, when you look at the measurement method used, and when you're looking at these gold standard 24 hour measures, then you see. Is abolished, and you see this kind of more linear relationship compared to these single spot measures where based on that data, that's where you were running into this J shaped curve.

One of the things that relates back to whether someone would even need to look at if an individual is salt resistant or salt sensitive, that might come up, is what we could think about. Well, does, would this even change the recommendations of let's say a dietician or a clinician if they're working with an individual by knowing this some people might think, well, obviously the this would because there's some difference.

But going back to something you said right at the top of the conversation Austin, was that even in cases where someone was salt resistant, so in other words, if they have a high sodium intake and their blood pressure doesn't really change at all, we shouldn. Conclude that is therefore meaning that a very high sodium intake is no problem to them whatsoever, or is no potential downsides.

I'm wondering, could you just elaborate on that point of this presumption we may have that Oh, salt resistant must mean I, I'm safe now. I'm I'm immune from any negative impacts of sodium. Can you maybe just speak a bit more to the nuances of that?

Austin Robinson: Sure. Yeah. So, it's something I can speak to even, I don't wanna say anecdotally, but I do have like, friends, again, started out as exercise science major.

It was really into like resistance training. Had a lot of friends who were also into sports and resistance training. And I remember one of my good friends his blood pressure is usually pretty low. And so he went through this phase where he was like, Oh, I can just pound sodium. Like, there's all this study, these articles I've read, through people that I respect.

And they're saying, Oh, high salt isn't necessarily bad and my blood pressure is good. So, , bigger guy, just eating a ton of salt. And I didn't know enough at the time to be like, Hey, man, you definitely shouldn't do that. But I was also kinda like, Eh, I don't know if you should do that. But over the years, like as I started studying it more and being in a lab that studied vascular consequences of high sodium, I mean, there are published data out there in, and I've contributed to some of these studies now too, where you could take a group of individuals who are salt sensitive and then you could take another group of individuals who are salt resistant.

So the way you would do this is you'd. Carry out your study, you'd have them consume their low sodium diet and their high sodium diet for a week each or 10 days each, however long the intervention is. And then you can of go back and classify who was salt sensitive? Who was salt resistant based on that change in mean arterial pressure that I mentioned.

And then you have your two buckets. So you have your salt resistant group and your salt sensitive group. And then within those groups you can compare changes in, in kidney function or changes in endothelial function. And so with endothelial function, the technique that we commonly use in applied human physiology labs is called flow needed dilation.

So for this technique, you basically use. High resolution ultrasound and you can obtain a nice image of the break your artery in the upper arm. And then you're using doppler ultrasound to track changes in blood flow velocity. And so if you have an image of the artery, you can track the diameter of it using the walls and callipers. That's usually done with kind of fancy software after the fact. And then from there you get a baseline image and baseline blood flow, and then you occlude blood flow to the artery. So what we do is place a high pressure cuff just distal to the elbow. And so that's rapidly inflated after you obtain your one minute or two minute baseline.

Different labs use different time points, but anyways, you include for five minutes. And then you deflate that cuff. And so when you deflate the cuff, that causes what's called reactive hyperemia. So there you go from this kind of ischemic time point to the reactive hyperemia where there's this large increase in blood flow and that should cause the blood vessel to dilate.

So a healthy, normal brachi artery with intact functioning endothelial function will vasodilate, and you can track that. And so with high salt, what we found in both salt resistant and salt sensitive individuals is that their brachi artery flow dilation is reduced. And so the reason we care about that is that there's these large studies, prospective studies where they found that impaired endothelial function is associated with future cardiovascular events and cardiovascular disease over x years of follow up.

So having impaired vascular function predisposes you to cardiovascular disease. And so again, whether you're salt sensitive or salt resistant, there's been multiple studies that have found that high salt diets lead to reduction in endothelial function. And then that's just the primary technique that a lot of groups use.

But there's other ways that you can assess microvascular function in the skin. There's plenty of rodent studies that have mirrored the human studies where they found using X vivo arteries that were cannulate and subjected to a technique called pressure myography, where they can track changes in, in a vessel diameter with changes in pressure and blood flow.

And then there's even some human studies out there where they've dissected out or resistance artery from an adipose depot like subcutaneous abdominal fat or gluteal fat. And so from there, you. Cannulate a human resistance artery and perform these different pharmacology experiments. And so there's multiple lines of evidence suggesting that high salt diets can impair endothelial function.

More recently, one of my first students here at Auburn, we published a paper demonstrating that in a cohort of 20 young adults who were largely salt resistant there was an increase in kidney injury biomarkers. So these biomarkers are typically used to study acute kidney injury. So the level of injury that we found wasn't anything crazy.

It wasn't like somebody that had just been, subjected to surgery or like a car accident or something like that. But there was these elevations and kidney injury biomarkers. And some of the larger cohort studies have found that these biomarkers are associated with future chronic kidney disease.

And we know from some of the population level studies that high salt intake is also associated with future kidney disease. So this was just one mechanism that might suggest how salt is increasing future kidney disease risk. So yeah, I mean there are a number of studies demonstrating some kind of negative physiological changes that occur despite no change in resting blood pressure.

And more recently we also published some work demonstrating that after 10 days of high salt, again, in a young healthy cohort, there were reductions in post exercise hypotension. So normally one of the benefits of exercise is after you undergo a acute strenuous spot of exercise, you experience a reduction in blood pressure throughout the rest of the day.

Compared if you were just sedentary. And with high salt, we saw that post exercise hypotension was blunted, so the magnitude of reduction in blood pressure was reduced. And then also during the acute bot of exercise that we used in that study, which was a 50 minute bout of aerobic exercise on a stationary bike, blood pressure went up more than after 10 days of consuming a placebo capsule.

Suggesting that there was a greater blood pressure response to acute exercise. And we also know from larger kind of cohort studies that have been prospective in nature that a higher blood pressure response to exercise is associated with higher risk of future hypertension. So you can infer that there's some early kind of blood pressure dysregulation occurring despite there being no change at rest.

Danny Lennon: Yeah. So, So that's. Really important because now we're getting to the crucial point of, okay, even in someone who is salt resistant, we shouldn't just simplistically think of sodium. The only thing we should care about is blood pressure. And if you don't see a change, then it's this completely free lunch.

Whereas there's all these other potential physiological impacts that we can look at. And I. While slightly different, but in the same type of vein, sometimes people who particularly who engage in sport can maybe take a similar view based on if we're doing a lot of activity. And of course there's some basis to this, right?

We know from, if you look at a lot of kind of sports nutrition, there's people that will typically tell you about the amount of sodium we lose in sweat during physical activity, particularly in hot climates. And so in, in many cases, particularly at very high exercise intensities where there's a lot of sweat loss that afterwards, rather than just rehydrating with water, we can include some electrolytes including sodium.

But beyond that, then I think just for the average person who does then exercise, there can be a presumption of, well, if I'm engaged in exercise or sport, does this mean that this is completely. Protective against a high salt diet in that if I'm gonna be excreting more sodium, does that mean that there's no problem in consuming more of that? Is that in any way an accurate conclusion to come to? Or is that a bit too oversimplified? What is the best way to think about this type of question that people may have?

Austin Robinson: Yeah, Danny, so that's another great question. I feel like it's something that I've thought about quite a bit.

So I think there's some nuance to this, but I also think there's a lot that we still don't know. So something that was odd to me when I started researching dietary sodium as a post doc was the recommendations are given in absolute terms. So I mentioned earlier, for example, the dietary guidelines for Americans is 2300 milligrams per day.

Again, for anyone who's at higher risk or trying to target optimal health, 1500 milligrams. But as like we all, we have different body mass, we have different physical activity levels, we have different caloric needs. So typically when we think about, how much protein does someone need or how much carbohydrate does someone need, we give it as a percentage of their diet are we say, consume x grams of protein per kilogram or per pound of body weight.

So this idea that everyone should consume 2300 milligrams always just seemed odd to me. And then once I started getting into the studies again, we would give people fixed amounts of sodium for low recommended in high. And for someone eating a high sodium diet, it might be similar in terms of sodium density.

If you normalize that sodium to their caloric. To someone else who's on the recommended if they're eating, two or two, two and a half times as many calories per day because they're just a larger individual who's really active compared to someone who's smaller and sedentary. So there was a study that came out in 2018 by Maureen Mertal and colleagues, and it was a secondary analysis of the dash sodium trial.

And so what they found was that sodium density was just as good or a better predictor of blood pressure changes than absolute sodium. And so to extrapolate that out to the real world, if you have, say, college athlete who's six five, or even, the six one or something, but they're 200 pounds or 250 pounds and they're doing two days, like they're gonna be sweating a ton of sodium, they're gonna be taking in more calories in general.

They need a different sodium level compared to, let's just say an older female who weighs 110 pounds and struggles to get three or 4,000 steps per day. So I do think there's some validity in that and recognizing that an athlete may need more sodium than someone who is sedentary and not really eating a ton.

But there's not a ton of data out there on that concept right now. So that's something that I'd really like to address in some of the future studies that we're planning now, is if we give sodium or manipulate dietary sodium that we manipulate it accounting for body size or chloric intake.

And that's even something played around with a little bit with data that I've already collected. I've presented that at conferences. It's not published, but we presented it at conferences and abstracts and things like that, where with our data set we saw that. Changes in blood pressure tracked pretty well with sodium density when we normalized sodium and milligrams divided by body mass and kilograms.

That's gonna be a pretty strong predictor of change in pressure. So I do think there is some validity to that, but there's just not a ton of literature yet. And then there's some limited data out there. So in rodents we know that rodents who are given a wheel to run on, so just voluntary wheel running.

It's like their form of, having a rodent go out and run a 5K every day or something like that. They seem to be conferred some protection against high salt diet compared to sedentary match controls. So in this particular study that I'm thinking of it's from Dr. Shannon Lennon's lab. They looked at changes.

Endothelial function. I can't remember off the top of my head if they used changes in flow to cause dilation in these arteries or if they gave an agonist like acetylcholine. But basically they found that there were changes in endothelium, dependent dilation in these x vivo arteries. And then they also performed protein expression studies and looked at changes in prooxidant and antioxidant enzymes such as NADPH oxidase and superoxide dismutase.

And it seems that high salt causes a reduction in antioxidant enzyme expression, which exercise was able to rescue. And then high salt also causes an increase in prooxidant enzyme expression, again, such as NADPH oxidase. And it seems that exercise was able to protect against that increase. So again that's just road data.

We don't know in humans, but there are also data. Suggesting that, and this again, limitation here, is that exercise was self-reported. So this is from physical activity questionnaires, but they looked at changes in gen salt. So this was a large study conducted in Asia and they looked at changes in blood pressure with changes in dietary sodium intake and individuals in the highest quartile of self-reported physical activity seemed to be somewhat protected compared to other groups in terms of changes in blood pressure.

And then the last study that I can think of, this was conducted about 20 years ago, and middle aged and older adults was a pretty cool study. They gave people a high sodium diet it was short term, I think it was just like a week or something like that, and looked at changes in blood pressure. So they were able to of classify who was salt sensitive.

Then they put them through a six month exercise intervention. And did the same thing where they gave them a high sodium diet, let's just say for seven or eight days, whatever it was, and then assess salt sensitivity. And they found that the incidence of salt sensitivity was cut in half. So it was a relatively small study.

It was about 30 adults. So I might not have the exact numbers right here, but let's say salt sensitivity. I think it went something from like 20 out of 30 salt sensitive. And then after the six month exercise intervention, it was down to like 12 out of 30. So it was cut almost in half. But that's the limited evidence out there, at least that I'm aware of.

Danny Lennon: Yeah, like you said, there's so many interesting questions that I think either haven't been addressed or that people maybe just presume have been answered. And I've seen like some in informal or even like opinion pieces that, that some have published in the area of on one side you'd see the very standard view of, well, look, athletes have these huge sodium excretions and so therefore there's a need to replenish that afterwards.

And then there's some people that have questioned that, if that is e even necessary. If over time is there enough of an adaptation that, do we need to replenish all of that? Or will that will there be an adaptation to that? Or is the kind of benefit of exercise in many cases getting excreting more of the sodium?

So there's a lot of interesting questions. But for the sake of the time, we'll maybe move to one of the other areas I wanted to ask you about where there has been some discussion clinically over whether a high salt intake is not only, maybe not necessarily as much of a problem, but could even be prescribed in certain isolated circumstances. And one of those being orthostatic hypotension. Can you maybe just quickly outline why that is discussed or what hypo orthostatic hypotension is, and then what kind of data do we have in this area? And what conclusions do you take from that current area of research right now?

Austin Robinson: Yeah, so there's a specific population. So it's post orthostatic tachycardia syndrome called mostly people just refer to it as pots. And so in this particular patient population, it's usually younger women for

the most part, people would consider them healthy if you were to just observe them out and about.

But when they go from like a supine posture to standing they basically have this increased tachycardic response, but they aren't able to compensate for the fact that they just don't have a sufficient increase in blood pressure when they stand up. And so that predisposes them to like passing out or just feeling lightheaded.

And even more mild forms that you mentioned, people who just have orthostatic hypotension, not necessarily passing out or having fainting episodes, but just feeling lightheaded, feeling like, Oh, I can't walk, as soon as I go from seated to standing or laying to standing. So just some decreases quality of life in general.

And so in, and these particular individuals, one of the things that is recommended is an increase in sodium intake. So that would result in an increase in plasma volume and maybe some other changes in terms of autonomic control of blood pressure that would result in greater tolerance. In terms of just going from that, again, supine or seeded position to standing.

And so that's been somewhat controversial. So a lot of physicians who deal with these patients of course they're gonna recommend something that leads to these kind of immediate improvements and quality of life. Whereas people who are more on the cardiovascular side and prevention side of things are kinda like, Oh, okay, hold on, let's see if there's some other strategies that we could potentially use. Good news in that area. There was a recent study that came out, I think it was just last year in 2021 that showed, and it was a fairly small sample size. In women with pots and then another group of individuals. So just women who didn't have pots, just like healthy controls.

They put them on low and high sodium diets. It was a short term study, I think it was like roughly a week, let's say. And there was no reduction in endothelial function reported in that study, if I'm remembering it correctly, in either group. And one of the reasons I'm remembering this is because, at least to my knowledge, it was, I think the third study that I was aware of at least demonstrating that women had less of a reduction in endothelial

function, or in the case of this study, a nonsignificant change in endothelial function.

So there's a couple other studies out there suggesting that women have less of a reduction in endothelial function, and then in that particular study there was no change. So. The conclusion in that study was hopeful or optimistic in the sense that if you have this population of young women who have orthostatic hypertension and the doctor prescribes that they eat a little more salt, it appears that they can do so without causing vascular dysfunction.

Again, it was a small study, short term. There's definitely a lot more data that are needed, but that's one population that it's currently recommended, at least by a lot of physicians. They could potentially more sodium to treat the condition that they have now. And then hopefully it doesn't lead to increase future cardiovascular disease risk.

Danny Lennon: Yeah. So we, we have pretty good reason to believe that at least acutely some of those symptoms resolve, but there are more those open questions about what that may mean for long term health. So, so these, so far we've discussed some of these interesting differences between individual.

Now one of the areas that you've published on and written very eloquently on as well, is along the differences between groups and particularly differences in race, and then how that relates to risk. First of all, maybe from an overview level, can you maybe talk about some of the differences that have been observed, and then maybe afterwards we'll dig into some of the reasons potentially behind that. But what are some of those initial observations of differences in risk based on race?

Austin Robinson: Yeah, so. Again, coming from multiple lines of evidence, there are some studies out there that have used the kind of short term controlled feeding approach and found that black individuals were more likely to experience changes in blood pressure or to be classified as salt sensitive.

And then there's some of these kind of larger studies where they've looked at the influence of sodium on blood pressure and found differences in certain subgroups. So they're, one of the papers I'm thinking of, like in the whole

population, there was a influence of sodium in blood pressure. There was more of an influence in black individuals and less of an influence on Asian individuals.

Again, that's an observational study, not necessarily like randomized controlled or anything, but there are a number of studies using the. Controlled feeding approach or sodium manipulation approach that have shown race differences where black adults were more likely to be salt sensitive. So I don't think that's an issue that's not entirely resolved.

I think there's enough studies out there showing that yes, on average black individuals may be more likely to be salt sensitive. I think what's the next frontier of that is well, okay, why? So some of the things that have been out there in the scientific literature weren't necessarily scrutinized to the extent that they probably should have been.

One of the ideas was, the transatlantic slave trade from Africa to the southeast United States created this artificial selection pressure where black individuals who were able to retain sodium better on that journey were more likely to survive. And then in the context of today's environment where there's plenty of fluid and plenty of salt, that's a negative adaptation.

And so that was something that was even publicized like on Oprah back in the mid two thousands, like Dr. Oz was on there and talking about it. But when I was preparing for my career development award and reading more about it, there's been a number of studies that have disproven that idea.

So there's been studies one, just like anthropological and historical perspectives discussing. You have to think like, obviously it's terrible that we had people being treated as just property, but in the context of if you're a slave trader and you're trying to get people from point A to point B, even if you're treating them terribly, you still want them to show up alive so that you can make your money.

So I mean, they did supplement with sodium chloride, they did provide salt. So I think there's less of that selection pressure than what a lot of people may have thought of. And then on top of that, there's been actual scientific studies. So like Dr. Ted Kurtz and Curtis Morris, there's a group who was

really active in this area about 20 years ago at the University of California San Francisco.

And they've done studies really specifically focused on African Americans and differentiated salt sensitive versus salt resistant groups. And they looked at things like changes in cumulative sodium balance or changes in renal blood flow. And so there's actually no cha or no difference between groups who are salt sensitive and salt resistant in terms of sodium retention.

But what seems to be the major kind of differentiator is changes in renal blood flow are renal vascular resistance. So somehow, the ability for the kidney to reduce any sort of our kind of buffer against changes in increased vascular resistance seems to be a major factor in terms of salt sensitivity, but not necessarily sodium retention.

So again, getting at what's causing these racial disparities Dr. Kurtz just published a paper, I think it was in 2020 or 2021, but what they found was that in studies that have given back potassium, so the increased sodium intake, but then also gave potassium that seemed to attenuate. The racial disparities that we see in salt sensitivity.

And then there's just been a number of studies over the years from big population samples. Even NHANES for example, has shown that there's not really a race difference amongst groups, at least in the United States and sodium intake, because that was one thing that you would see in the literature.

Sometimes, like perhaps black individuals consume more sodium and that's why they're more salt sensitive, but there isn't really a racial or ethnic difference in sodium intake. But what there does seem to be a difference in is potassium intake. And I think when we look at potassium, it's more of a surrogate for.

How much fruit and vegetable are people eating, fresh foods? Just access to what we would generally agree is more healthful foods. So in the context of if one group is eating a less healthful diet because on average they have a lower socioeconomic position, or less just wealth in general, or they have less access to healthy foods because there's less grocery stores in the area or

something like that, then I could see that being a major contributor to some of these differences that we see in salt sensitivity.

But it just hasn't really been thoroughly studied. So that's again, one of the reasons why wanted to conduct this career development award and assessed things like habitual diet and physical activity and some of those social determinants that might contribute to some of the disparities we see in Salt Sensit.

Danny Lennon: Yeah, it's interesting because thinking about those social determinants that even if you go beyond thinking about salt sensitivity, we just think of impacts on either blood pressure or even beyond that just cardiovascular disease or more generally or a range of health outcomes. As we've discussed in this podcast before you think socioeconomic groups and you think of, okay, in cases where there's a lot of social deprivation and poverty, there's a whole culmination of factors that all almost like add up on top of each other and continue to exacerbate this issue. That one that you've noted is, okay, differences in access to certain foods, and so therefore, if you're having less fruit and veg, that's one thing, but now you're also in a context where the the environment that surrounds that person in terms of stress, crime rates et cetera.

A whole host of factors can also play into impacting risk of some of these outcomes like blood pressure or cardiovascular disease. Right? So it, it seems like it becomes quite quite a culmination of factors ultimately that we're trying to parse between to see these differences in something like salt sensitivity.

Austin Robinson: Absolutely. I mean, I couldn't agree more. As I mentioned earlier, one of the risk factors for salt sensitivity is just having other cardiovascular comorbidity, such as hypertension or impaired renal function. And so, as you mentioned, if you take one group of people and just at least in the United States based on color, they've been, they faced historically less opportunity, segregation, racism.

And so that's ended up in a group of people who, on average have lower socioeconomic status, are exposed to more crime, more stress, financial stress, just all these different stressors that could compound and lead to someone having less. Ideal health. Then of course that would also contribute

to assault sensitivity in addition to all these other things too, such as hypertension or increased stroke risk or chronic kidney disease risk.

So it's definitely something that, as physiologists, we're not necessarily trained to think about. But I think that's the wave of the future. There's a lot of groups now who are trying to start to collaborate with psychologists or people who are into population health science and see if we can work with them to capture some of these social determinants and health behaviors that might contribute to health disparities.

And then see if they track with some of the measures that we make that are indicative of increased future risk. And so maybe we can come up with ways to intervene. I mean, obviously a lot of this would just be policy level changes and things of that nature, but if we can come up with some mindfulness techniques or like different supplements or health practices that we could use to intervene, I mean that still would result in less disease incidents and increased health span and quality of life. So it's definitely some... it's an important area.

Danny Lennon: Yeah. Yeah. I mean there's so many layers to it because just as you were saying that, thinking back to some of the things that relate to not only blood pressure and cardiovascular disease, for example, one factor that is commonly discussed is something like sleep. On this podcast we had Dr. Michael Grandner talk about some of their work and sh talking about some of the data where if you look at sleep issues and chronic poor sleep, you have now evidence of the extent and frequency of racism that certain people have faced directly having this long term chronic impact on sleep. And therefore this is gonna impact a whole host of health outcomes, one of those potentially being blood pressure.

And so this again, just shows that the complexity of these issues, that really looking at it in a very isolated one pathway or one physiological system, probably isn't gonna. Do the trick ultimately when we're looking to see what changes need to be made at both a population level or even just a community or individual level.

So yeah it's it's certainly so complex. So before we get to rounding this out, Austin cause I've really enjoyed this. Maybe just from your own perspective and your plans for the work you've got ahead of you over the next few years.

You've already indicated some areas you'd like to explore, but if we think about next five plus years and the questions in research you would like to see answered, what some of the work that either you're excited for your lab to do or maybe even others to investigate, what are some of those open research questions that you think are next in line that would be really good to, to get some data?

Austin Robinson: Yeah that's always an exciting question to talk about. So you really just refreshed my mind here the importance of sleep. And you mentioned Dr. Grandner and one of the health behaviors that we do assess in the lab before anyone comes in for any sort of experimental visits, we always have people do physical activity assessments and sleep.

So we use Actigraphy to assess sleep for two weeks. And from there we're able to look at things like sleep duration, sleep efficiency, and sleep variability. And so that's one of the kind of health behaviors that we're really interested in. And I have one of the graduate students in the lab, me Culver, who's really led those efforts for me in the lab over the past couple years.

And right now, one of the things that we'd be interested in is sleep extension. So as you mentioned, Dr. Grandner mentioned it. There's other great researchers in that area of sleep like Chandra Jackson, Dana Johnson, Susan Redline who are really looked at sleep and racial disparities in sleep duration and how that might influence blood pressure.

And so one of the things that we'd be interested in, she's thinking about it for a dissertation topic, is sleep extension. There's very little research out there on, okay, we know, sleep poor, sleep is bad, but what can we do to target that? And if we do increase sleep duration or improve sleep regularity, can we actually improve health outcomes?

So there's pretty limited data on that right now. There's a study that comes to mind that basically add people go to bed. An hour longer per day. So they could either sleep a little longer in terms of trying to go to bed a little earlier or sleep in a little longer. As long as they tried to of get that to add up to an hour.

In reality, the participants achieved about a 45 minute extension and that led to reductions in blood pressure and that was very cool study. I think it like a

great jump off point, but one of the things that we'd like to do is do a sleep extension study and see how that affects other measures of vascular function that have been associated with poor sleep.

And one of the things that we want to emphasize for that is to bring in a diverse cohort. Cause as you mentioned, that could be one of the things that's mediating racial disparities and blood pressures, just the differences that are documented out there with sleep. So I'm, sleep is newer to me.

It's not like the main thing that's driving our research right now, but that's definitely a question that I'm really excited about. And then in terms of the dietary salt work, one of the things that we've discussed today, like in the context of the dash diet, how consistently, irrespective of sodium level, it was associated with a lower blood pressure than a standard diet.

And one of the things that I think can get lost in the nuances, there's other factors in the diet other than sodium. So if somebody is preparing most of their own meals, they're eating a relatively like high fruit and vegetable diet. They don't eat a ton of processed foods. If they add a little bit of salt to their food yeah, maybe like, who knows because we vary as individuals, but like the data would suggest that maybe they would be better off to not add salt to their food.

But I think in the context of a relatively healthful diet, occasionally adding salt would still put you in a much better position than someone who is habitually eating, just a processed diet that's really high in sodium and fine carbohydrate and added oils and added fats just on a day to day basis.

So that's something that I'm interested. Now we're doing some work cross sectionally where we've had people fill. Diet logs and we're interested in not only sodium, but if we look at sodium in relation to other nutrients in their diet such as potassium or fiber, are those who consume the highest sodium in relation to other somewhat protective dietary factors?

Are they at even greater risk compared to if we just looked at it as sodium intake? And that's informing some of our future ideas. because again, there's these recommendations and then there's how many people meet their recommendations. So roughly nine and 10 adults eat more sodium than what's recommended by the dietary guidelines for Americans.

So it doesn't seem like, we're gonna have this kind of awakening as a society where everyone's reducing sodium intake. It's just so hard because 70% of the sodium that we eat comes from process and packaged food. Some of it's naturally occurring. If you look at like the percent of sodium that's added in our food, it's only like 6% is added at the table and like 5% is added during the cooking process.

So we're just trying to think of ways that we can maybe protect against the negative effects of sodium without getting people to reduce sodium per se. So one of the ideas that I've been excited about there is preclinical literature suggesting that high sodium diets reduce endogenous keto production.

So there's some sort of change in metabolism that's occurring with sodium and we know from some of the larger perspective studies that sodium intake is associated with increased obesity and adiposity. So it would make sense that there's these changes in metabolism that are occurring. But there's also data in rodent suggesting if you give them one three butan dial, which increases KEYone production that seems to protect against some of the negative effects of salt.

So, quick, safe way to do that and humans would be to give them a ketone ester supplement. And that's something that we plan to start very soon. We have some funding to do that and we plan to get into that area. And then just with other collaborators, we've bounced around some other ideas on what are some supplements that we could use or different dietary factors that we could try to increase to prevent the negative effects of sodium.

So right now, we know from previous literature that if you increase potassium and sodium, the increased potassium seems to attenuate some of the negative effects of sodium. But there's a lot of really cool preclinical literature out there in rodents suggesting things like dietary nitrate may also prevent some of the negative effects of sodium, but there's not much human literature out there, even on just basic stuff like blood pressure.

So if we could give things like that and assess blood pressure, And endothelial function and kidney function and the gut microbiome and things like that. I think that's a really exciting area just because there's so much literature out there on sodium and cardiovascular health and other health

outcomes, but there's not really much out there on, okay, what can we do to prevent it?

And I think that's something that we have to focus on because again, it's just so hard to reduce sodium content in the diet for most people.

Danny Lennon: Right. Yeah. And especially when the message is reduced sodium, because typically, like you said the real change is gonna come about when you see a shift in the overall dietary pattern as opposed to just focus.

Reducing salt because as you noted, most of that sodium is coming from the actual food supply and the types of foods people are consuming. And then beyond that, some of the other things that you mentioned around potassium or we even polyphenols that are in fruits and vegetables, they're gonna come about from changes in that dietary pattern shift as opposed to thinking about one or two nutrients in isolation.

So yeah, that, that's really fascinating and I'm excited to hear about all that potential work that could be ahead of you and your colleagues. So before I get to the very final question Austin, for people that want to find you on social media, learn more about your lab's work or anywhere else on the internet that you might want to send their attention towards where are the some of the best places to find you and your work?

Austin Robinson: Yeah, so we have a lab website. I do need to update it. I haven't updated it in several months now, but we have a website at Auburn University. We are the Neurovascular Physiology Laboratory. I'd really like for people to check us out on there just because it has all of our lab personnel, so you can see the graduate students that are helping push this research forward and some of the different funding opportunities that we've been able to secure and the scope of the project so you can read a lot about what we're up to there.

And then personally I spend a decent amount of time on Twitter and that's really the main place that you'll find me online. I try not to spend too much time on social media, but Twitter's like my one vice where I'll get on there and follow other scientists and that's a good spot for me personally to see new published literature because I'm always following like other journals and

stuff like that. And I tweet out things quite a bit too. So that's probably the best place to engage with me on the internet.

Danny Lennon: Fantastic. And for everyone listening, you'll of course find that linked in the show notes page or wherever you're currently listening in the description box, they will be linked up there as well as any of the relevant literature that we've discussed today.

And so with that Dr. Robinson, that brings us to the final question I always end the podcast on, which can be to do with anything at all, even outside of today's topic. And it's a generic large one, so apologies for putting you on the spot with it. But if you could advise people to do one thing each day that would have a positive impact on any area of their life, why what might that one thing be?

Austin Robinson: Yeah, for me I'm just gonna go with what's important for me and helps me, I would just say make time to get at least 30 minutes of exercise that you enjoy every day. Whether it's resistance training, going for a run, going for a bike ride, a brisk walk that's probably the exercise scientist in me, but I just know I could be having like the worst day and after I go, for a run or I get like an intense spot of exercise through resistance training in like, I just feel infinitely better just in terms of my mood and then I know doing that is gonna help with my, health span and quality of life and kind of keep me out of the hospital hopefully.

So, that, that's been my big one. If I could recommend something for anyone, it would just be take time to, to do some exercise that you actually enjoy every day.

Danny Lennon: Awesome. Yeah, and I think the data is on your side with that one. I think it, it certainly agrees with that anecdote. So, with that, Dr. Austin Robinson, thank you so much for being so generous with your time today for coming and talking to me. I've really enjoyed this conversation. And even beyond that, I've really enjoyed consuming much of your published work and learning from it. So thank you for what you've contributed to the field, and thank you for taking the time to come and talk to me today.

Austin Robinson: Yeah, thanks Danny. It's been really fun to be on the podcast. You ask some great questions and hopefully hopefully the answers are useful to some people out there.