# Cardiovascular Performance, and More - An Interview with Dr ...

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brown adipose tissue, microbiota, exercise, probiotics, mice, microbiome, microbes, antibiotics, humans, studies, people, lab, female, interesting, skeletal muscle, diet, aspects, question, hypertrophy, linked

**SPEAKERS**

Dr. Mike T Nelson

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D Dr. Mike T Nelson 00:00

Welcome back to the flex diet podcast. I'm your host, Dr. Mike T. Nelson. On this podcast we discuss all things to increase lean body mass or muscle, decrease body fat, increase your performance, all without destroying your health using a flexible approach today on the podcast and my good friend, Dr. Sarah Campbell. And you may remember her from the previous episode, where we talked about exercise and gut health. And today the podcast is brought to you by the flex diet certification. This will open up again in January of 2022. So the flex diet certification is eight different interventions to maximize your knowledge in nutrition and recovery. This can be for yourself, or it was specifically designed if you are a coach, as a complete system of how to know where to start with your clients regarding nutrition and recovery. So the eight interventions cover everything from protein to dietary fat carbohydrates, obviously, your macros, sleep neat. So non exercise Activity Thermogenesis aka walking around movement, exercise, fasting, micro nutrition, and much more. The nice part is I put it in a complete system for you. So you understand the context of the system, just based on metabolic flexibility and flexible dieting, you'll understand a technical primer on each one. So you'll know all the details that you need to know. And you'll have the explicit action items of what to do for each particular one. Each intervention comes with five specific action items and a system so that you can lay them out for your clients and a flexible approach. So it opens again, January 2022. As of right now, we also have CPUs for it through the NSCA. Possibly CrossFit next year, we're still waiting to hear back from them on that NASA and AC E. So if you're looking for CPUs to get ahead of the game, this would be a great place to get them also. So go to flex diet.com flxdt.com. As I mentioned, Dr. Sarah Campbell is back on the podcast again. She did an earlier episode that will link to about exercise and gut health. I got to see her recently, I was I was out presenting for the ACSM meeting there about four weeks ago in Pennsylvania, which was an awesome time. And we talked about some brand new research that she is working on with her lab. super interesting. Especially the parts where we talk about the relationship potentially between antibiotics and your gains. This could be type one muscle hypertrophy, and even changes in a robic cardiovascular output. These were done in some early my studies. But some really, really interesting information. She is in the process of submitting these for publication. So you'll be able to hear all the latest information before it is

even in the old PubMed. So brand new stuff that you so far haven't really seen, talked about anywhere else. But really good stuff. So Dr. Campbell, is the director of the graduate program in kinesiology and Applied Physiology. She is an associate professor there at Rutgers University in the Department of Kinesiology and Health. She is a PhD, also a faculty at the ACSM American College of Sports Medicine. Her lab is affectionately known as the Red Dragons or also the poo crew, since they are looking at fecal samples in order to determine impacts on the gut microbiome for many different interventions. And at the end, we also talk about some very cool stuff on cold exposure and brown adipose tissue and how that may work also, so enjoy this a great interview with Dr. Sarah Campbell. We do have a little bit of audio that comes in in and out probably around halfway or a little bit after we tried to clean it up as best we could. So I apologize for that. You know, internet wasn't in our favor, but I don't think it interrupts things too much. So enjoy this interview with Dr. Sarah Campbell. Well, thank you so much for being back on here. I appreciate it. You're on you're talking about God health and exercise and season two episode are nine. So it's awesome to have you back and you've got some new, super cool data for us again. Yeah. So

well, first thanks for having me. It's always a pleasure to visit with you. But also thank you for coming to Harrisburg to, you know, give that awesome talk to the mid atlantic ACSM chapter meeting. So yeah,

D Dr. Mike T Nelson 05:21

thank you for inviting me. That was super fun.

It got fantastic feedback. So

Oh, good.

Yeah. I mean, like, when you gave a wonderful talk, I mean, it was super well attended. You know, and it was just wonderful to have you and then to, you know, get to go out and enjoy some beverages and fun things like that, too.

D Dr. Mike T Nelson 05:41

Yes. The trolls brewery or troll, troll trolls. Right. Rogues? Okay. Yeah, yeah. Next Thursday, there was? Yeah, they had really good dark beer, really good food, and just a super cool place. If people around that area I'd recommend they check it out.

if people around that area I'd recommend they check it out.

Yeah, definitely. And, you know, it was a company, I worked with some really great people in the chapter who, you know, we had a nice conversation with so that was fun, too.

D Dr. Mike T Nelson 06:06

Yes. And one of them was visiting White Bear Lake. So we'll get together when he's in town. Yeah.

morskie. Yeah. Yeah. To funny. Nice. So, anyway, so let's chat about this crazy data we have going on

D Dr. Mike T Nelson 06:21

here. Yeah, wherever you want to start and jump off. I know, you know, you can decide whatever you want to make public or not, I'll leave it there.

Well, you know, what's, what's interesting is her, you know, finalizing some of those, you know, publications and, you know, a lot of its had to been sent off to, I mean, NIH is part of, you know, grant proposals. So it'll eventually be out there anyway. And then, you know, my colleagues at Kentucky in John McCarthy's lab, and Taylor Valentino is the lead author on that paper that just came out so that on skeletal muscle and how providing antibiotics kind of, really diminishes capacity to have hypertrophy. And in particular, those, you know, type one muscle fibers in these female mice. So,

D Dr. Mike T Nelson 07:09

talk a little bit about that to start, because I think that would be like very newsworthy, or something that is novel, and but yet common that happens in humans got it's done in mice, but still very interesting. Right. And

so, I mean, I kind of piggybacks on some of the conversations we had in Harrisburg to kind of, you know, tell the group about that a little bit. But, you know, there's a John McCarthy's down in or over and down and open. And he's been, you know, looking at skeletal muscle for a while, and he has this really unique power pow er protocol that he uses to induce hypertrophy and,

and look at some of these, you know, really cool aspects of how muscle adapts to exercise regimes. And I had the privilege of, of his doctoral student Taylor Valentino inviting me to come down there and talk a little bit because they were getting interested in the microbiome. And so what they did is they took a cord of female mice and kind of in introduced them to this, you know, power protocol that they use for hypertrophy, and then for a period of time, gave them some, some antibiotics. And, you know, for for those who aren't necessarily in the microbiome world, you have an aspect of using a germ free mouse, which is kind of like a mouse in a bubble, who has no bacteria, and so forth, or an antibiotic treated to eliminate the bacteria, you know, germ free mice, as you could possibly imagine, are really expensive to house, the facilities have to be super special and built in a way to antibiotics is usually a nice way to very inexpensively conduct experiments on a lack of a microbiome. So they, they gave these, you know, female mice and antibiotic treatment and kind of then looked at some of the outcomes related to hypertrophy and adaptation and so forth. And, you know, noted that there was a disruption in the ability of the type one muscle fibers which are the more slow twitch associated with the aerobic capacity to hypertrophy. That that was a really exciting finding to start, you know, this platform of, you know, us now getting some data out there on what we've been seeing and the skeletal muscle of mice that we've been working with. And, you know, and anecdotally, is always interesting to you know, do Do you know, a lot of people who like to work out on their antibiotics or when they're being on, you know, treated on antibiotics, and know that's confounded by maybe their illness. But, you know, as we were talking, it would be interesting, maybe just give healthy individuals, you know, humans, antibiotics for, you know, a week to something that's pretty broad spectrum that's going to not knock a bunch of things out and See if that kind of eliminates the training induced adaptations to exercise. And

D Dr. Mike T Nelson 10:07

that'd be, I don't want to say, an easy study to run, because no studies are easy when you involve human subjects and all that kind of stuff. But in the grand scheme of things compared to what you could do, it's on the easier end of the spectrum, right? You could make it a randomized blinded, placebo control, you could have, you know, markers of aerobic performance, or VO, two max or things that are commonly available in the lab, IRB approval would probably be relatively easy, all things being considered. So suddenly, I think something that's quite doable without, you know, million dollar equipment and everything else.

Right, no, definitely. And, and even just showing maybe that, you know, VO two Max is reduced as is a place to start, because I know that some of what what we're seeing our lab is things like work to exhaustion and, and running distance are significantly reduced. You know, when we give the mice these antibiotics, and this seems to be whether they're male or female mice, it seems to be equivalent across across the way. What's interesting is the the lack of the microbiota kind of eliminates what many have shown is a sex difference, in particular, of female mice tending to run more than than male mice. Interesting. It's translatable to humans. But understanding the sexes becomes a really interesting, you know, phenomenon, what, you know, what might regulate that. But that loss of microbiota eliminates that all of a sudden, you don't see males or, or female mice being able to, you know, have as long running distance and door work to exhaustion. So,

D Dr. Mike T Nelson 11:51

so could some of that be related to the microbiome in female versus male mice, just at baseline that's allowing the female mice to run longer.

Right, so um, so we definitely have noticed. So all these things I'm talking to you guys about, I'm like thrown out there and papers in prep. Right, so hopefully, the next four papers get out before someone decides to scoop us. But, um, you know, we definitely noticed there are our baseline differences in the communities that are predominant in males versus females. And this translates, you know, very, at least minimally to the microbial derived metabolites, which a lot of times are measured as the short chain fatty acids, and those are very different between the male and female mice. So then becomes the, you know, mechanistic studies, which we're proposing to really try and tease out, you know, what aspects of the become important in the females versus the males and, and how they might be linked to exercise capacity. So, there definitely are baseline differences. Most, you know, humans also a lot of human studies, report differences and in microbiome between, you know, sex. So, you know, that's a, that's a fun question that we hope to answer over the next couple of years.

D Dr. Mike T Nelson 13:15

Very cool. And if we pick up to the hypertrophy study that was done in mice with the type one fibers it only affected type one fibers? And do we know the mechanism was like muscle protein synthesis changed or any ideas as to what might be going on? More further down the molecular chain, I guess,

you know, I think that they probably looked at a couple of things, I have to go back and maybe email you and we can put it, that's fine. But I'm sure they looked at a couple of things that they have a huge skeletal muscle, you know, phys lab down there. So I know that they engaged in looking at immunohistochemistry and various aspects of it within the muscle, I don't want to misquote them so no worries. Um, so let me go ahead and I'll send you some of that data and published I can forward you that information. But it's really neat. And especially since they use female mice and showing this disruption to the type one you know, muscle fibers because we know females typically have a greater abundance of type one muscle fibers compared to males anyway, which sometimes is linked to you know, the aerobic capacity and you know, the the maybe drive for you know, some females be in longer distances and it's opposed to maybe males so it's it's been an interesting exploration into sex differences with the the grant that we just put out here right before Thanksgiving looking at a lot of those.

D Dr. Mike T Nelson 14:45

And I, I think in humans, like the only events that are coming to me that I guess for more strength and power or pure endurance that females have actually won more considerably more Ultra Marathon events, correct?

Well, yeah, so addition to the type one fibers, they show a lot less fatigue ability compared to males. So it would make, right, they have this drive to kind of go longer and further. So

D Dr. Mike T Nelson 15:13

I've often wondered, how much of that do you think is females are just better at pain management? Is if you're doing like an ultra marathon, which I don't do. I got to imagine at some level, it's a lot of it is just pain management. I mean, even if you're at the elite level, it's just a suffer fest.

You know, I longest thing I've ever done a half Ironman, and I can. Yeah, that's it took about seven hours. Oh, yeah. So, um, and there were definitely times I mean, it's Panama City, you know, I did it while I was in doctoral school, and even in wow, I mean, it is Gore Ching, you know, sort of like cramping and you know, trying to get off a bike after 56 miles and then run a half marathon. So I would definitely agree with the whole pain management aspect, you just kind of, you know, almost got to get in, that's where sports psychology becomes really interesting. You just got to keep telling yourself, you just have to do it, get through it, you'll be you know, almost there one more mile and then reevaluate. And, okay, one more mile. And let's see how, yeah, engaging a lot of those kind of mechanisms. So cool. Yeah. So you know, but that that interesting, the, you know, brings us to, you know, some of the interesting aspects of, of looking at the way the microbiota might interact with the skeletal muscle. And so, in addition to the changes in hypertrophy, there's some really interesting changes to, you know, oxidative capacity of the mitochondria. So we're, you know, really interesting, and taking a look at skeletal muscle and looking at things like, you know, cytochrome, four, and, you know, citrate synthase activity, and all of those kind of key markers that are typically looked at, and, you know, it seems that with with the antibiotic training, or the antibiotic therapy, it really does eliminate the training induced adaptation to those. So you see the response where it's, you know, has a baseline level, and then will significantly increase as a result of exercise, which is, you know, the norm, but then you see, you know, it's just a week of this antibiotic therapy, that that training effect is eliminated. And oftentimes, it's even below what baseline would be.

Oh, wow. So even goes negative.

So it it even goes, you know, too much too much lower extent. And so, you know, the next question, as you've been asking, is what what's driving that right? Now, the the questions are, I'm not, you know, we're not sure yet, you know, we're collaborating with people who look at

this transcriptome and the genomes to to try and understand what that looks like in the skeletal muscle, you know, pre exercise training, post exercise training, and then what's there and what's not, you know, when the antibiotics are given, you know, we're looking at the metabolome, as well, in fact, my students just dropped those samples off, you know, last Friday, to start looking at some of the metabolome with the antibiotic treatment, as opposed to, you know, pre and post exercise. So, I think those will start providing targets to where you can, you know, start making valid hypotheses about what might be, you know, interfering here or there. So, I don't know, we'll see, we really

D Dr. Mike T Nelson 18:35

Yeah. If you were to speculate, do you think this is transferable to humans? Or do you think this is something we're seeing only in mice, right? Because the the criticism of mice research or mouse research all the time is, Oh, great. It's in a mouse, it's not a human, blah, blah, blah. But the same point, you have to start somewhere, as you know, there's tons of things you can do on mice very easy, that are almost hard or impossible to do on on humans. So it's a valid question, but at the same point, there's pros and cons to both ends of the spectrum.

Right. So that's, that's an outstanding point. I mean, we get asked that a lot, particularly with my own research, simply because, you know, humans have such varied diets compared to a mouse where you're feeding either that control diet and they're happy to eat it every day or a high fat diet, which they're happy to eat every day. And, and the reality is, is they're similar through certain levels of taxonomic resolution. But clearly when you start getting into the much lower levels, you know, which species are there, what strains are there, there's there's obviously some overlap, but that's where you're going to see some of the divergent things. So ensuring that there's some replication with humans would would be nice and we do know that there there is some of that with some of the data that's come out in particular with some of the finale bacterium pregnancy and some of the butyrate producing bacteria that are seen in humans as well as the animal studies. So that's a nice, kind of like check mark, that we're at least in the right realm of things. But yeah, so, you know, designing those kinds of studies is, as you said, would be, you know, quote, unquote, as we say, easier, again, not totally easy. But you know, I think that they would be interesting. You know, what might make it a little more complicated to answer those questions in terms of an IRB is the desire to get, say, a muscle biopsy, right? Because then you'd be able to take a look at the muscle biopsy and run some of those, you know, what are the mitochondria look like? What are their enzymes look like? Do I think it would translate? I I'd like to think that there's probably something there that, you know, the microbiome just doesn't, you know, control over these things in animals and does nothing in humans. I mean, we were aware that, you know, diet, and, you know, exercise do produce effects in humans, and the microbiome is responsive to both diet and exercise. So, I don't see why, you know, exploring what we're seeing in the mice in humans would be invalid. And and I wouldn't be surprised if there was some overlap with that data.

D Dr. Mike T Nelson 21:17

Oh, very cool. I'm just gonna turn my video off here for a sec, because my internet connection was kind of unstable there, but hopefully that'll help.

Okay, what what do you think I'm curious about what you think? What do you I think I think it would be I think there's some things that are

D Dr. Mike T Nelson 21:32

similar. Ooh, I think we're having all internet connection. Hear me hear me now. Yeah. Okay. Yeah. So hopefully, someone, maybe your lab or the Lab version of that, because it's, it's something I think that athletes deal with a not all the time, but a fair amount. Right. It's not one of these far out things. It just never happens in sport, or, or to people exercising. So it's something that it'd be interesting, just from a performance standing. And then obviously, the whole next. Yeah, so I was just saying that is something that does happen to two athletes. So it'd be interesting to see if a one is a real thing in humans, and then two, obviously, the mechanistic path of what may be the result of that or the cause of it. Right.

Right. And, and, again, you know, our lab gets interested in sex differences. So does it work the same? Right, and chances are that is more reality that the chances are that that, you know, the difference between this the sexes don't work the same way that there's a different mechanism, you know, mediating something, it might eventually converge on similar, you know, aspect, but it might not work through, you know, similar pathways, which is what I would anticipate.

D Dr. Mike T Nelson 22:49

Yeah, super cool. So, how long before we have a probiotic supplement that will target a robic performance?

Right. So that's interesting, because there is some already there are some already out there. I think the last I think the last time we checked, we might have actually looked so we probably should, I probably should take, but there was a fit biome probe probiotic that hadn't been either released or in the works. It was in response to the paper that came out looking at them that showed this villa nella, I think that's how you pronounce that. Species that that appeared to be linked to lactate metabolism. So lactate more on the consumer consumption consumption side, rather than the production side. So this, this micro might have been helping to, you know, kind of process the lactate in the marathon. And I am pretty confident there was, like I said the Fit biome had developed something. I'm not sure if it's on the market yet.

Oh, interesting. Yeah, so

Oh, interesting. Yeah, so

I'd have to check. I know the the one microbe that tends to be really influenced by by exercise. And among other things like diet for Kelly back to your pregnancy is definitely already a probiotic out on the market. You know, so anybody who hears that microbe and says, Oh, I hear it's been associated with, you know, exercise, you know, could think to take something like that. But my guess is is probably not if that one isn't already on the market. There's others potentially in development.

D Dr. Mike T Nelson 24:42

So do you think the, the current probiotics would be beneficial? I know we chatted about probiotics a little bit last time and a follow up part to that is probiotics in general. I believe after you stopped taking them, you kind of then revert back to more baseline there. not, uh, not really lack of a better word permanently changing the landscape per se.

Right? So you definitely got that 100% Correct. So the, you know, the first, you know, we can intertwine, you know, both of those questions. So, you know, the, the second part first because that'll kind of lead into then, you know, what about probiotics and so forth. So, believe it or not, you know that the microbe, you know, biota, really, the microbiome, I should say, is, is pretty fixed, starting around the age two or three, that's pretty kind of well established. So, you know, things like, route of birth, um, bottle fed versus breastfed, you know, Introduction to solid foods, early life exposure to antibiotics, and all of these things tend to shape that microbiota, until, you know, like I said, about two or three years old, and that's been kind of yours. And, you know, what's, what's interesting is, it kind of takes a chronic application to change the microbiota, which is a lot like exercise, right? When you exercise, when you stop exercising, you tend to start losing those effects, right. And so the microbiome works in a very similar way, you can take a probiotic, and take it to kind of have to keep taking it every day. Otherwise, you know, once you stop it, it potentially, you know, will revert itself back to what your kind of regular normal microbiota was, you know, as established when you were younger. And so what's also really interesting about probiotics is that, you know, you the common ones are, you know, the Bifidobacterium, and lactobacillus, and we know that those are really important beneficial microbes, and they might regulate the populations of some of the other pathogenic ones. But with regards to exercise, I always like to show a slide during my talk, when I talk about free in probiotics, is that a lot of the microbes that seem to be benefited, or altered as a result of exercise training, you know, to your point, you don't necessarily see in what the typical over the counter probiotics are. Right, so the development of an exercise specific probiotic, would be interesting to see how that is, you know, but you might be giving someone lots of lactobacillus or Bifidobacterium. And ignoring the other, you know, microbes and what we call genome interaction groups, and how these microbes kind of work together and communities to be symbiotic with the host. And you might be kind of pulling that in one direction, if all of your feeding is a probiotic geared towards Bifidobacterium. And lactobacillus if that makes sense.

D Dr. Mike T Nelson 27:48

Yeah, it's, it's kind of like, what are the unintended consequences of it? Like we something like companies in general, consumers, everybody, we want the answer for the thing that's like, oh, this particular strain? Well, let's, you know, take a whole bunch of that, and then that'll help everything. But like you said, maybe that disrupts the whole ecosystem, and maybe you get a little bit of a robic performance, but your gut health is a disaster. Now, who knows? Right, right.

I mean, the idea is, you know, what are their trillions upon trillions upon trillions of microbes. And while granted, there are ones that, you know, researchers believe are foundational and critical for the overall stability of the microbiota, they still have to interact together in that community to keep each other in balance, and, you know, pulling those in any sort of direction, you know, might not be the best idea. I mean, I think that there's a reason that the NIH still calling for mechanistic studies of how probiotics work to, you know, illuminate the fact that we really aren't sure how or why or if these are working. Um, so I think that that's, you know, a point to be, you know, taken. We do know that, you know, the the ISSN released a position stand on, on probiotics, and, you know, basically, you know, most of the literature will suggest that it's more, you know, not directly helpful, but maybe indirectly helpful on reducing sick days. But if that, you know, the evidence isn't exactly overwhelming, for showing that it definitely improves, you know, aerobic capacity or anaerobic capacity is more of an indirect help. As in, hey, if you're sick less days, you can train more days. Right? And that might be beneficial for performance because you're not taking days off.

D Dr. Mike T Nelson 29:43

Yeah, and obviously, the context we're talking about here is then by little air quotes, generally healthy people. Once you get into you know pathologies and that whole area, that's a whole nother realm in and of itself, too.

Right. And I mean, because diet is such a Big modulator, the gut microbiota, I mean, you know, your little air quotes kind of gets extended when you start talking about these athletes, because they might tend to eat better rates. So there are several factors that might shape their microbiota that are, you know, different from, you know, the average individual. Right?

D Dr. Mike T Nelson 30:19

Yeah. Very cool. Before we transition to some possible stuff on temperature, anything else in the area of gut health and probiotics and interesting stuff you wanted to share?

Um, no, I think, I think that's about it, I think, you know, the, you know, a lot of the big things with the bugs isn't necessarily a prebiotic probiotic, but a prebiotic. So the bugs the foods that they like, right, you know, they like those complex carbohydrates, you know, to create those short chain fatty acids, which, which keep the gut, gut healthy. So, you know, as we always, you know, teach our students in the nutrition classes, you know, make sure that you have, you know, enough total calories, and then you start getting into, you know, that balance between the carbohydrates and the proteins, and then the fat and discretionary calories. And I think, using that prescription, you know, especially engaging in the fruits and the vegetables, and those, you know, those fibers that the microbes like to degrade, you know, really kind of will help promote that healthy gut.

D Dr. Mike T Nelson 31:25

Awesome. And can you supplement like the short chain fatty acids themselves? And is that beneficial?

Right, so I think, I think there have been, um, are starting to have come out with some more studies on that in, in humans. Um, you know, it would be great to think the that you could do that, um, you know, I think the other question is, do the short chain fatty acids work to augment that gut health, which then, in turn, in turn, you know, augment systemic health through again, mechanisms that we're trying to figure out? Or is it the actual, you know, serum or plasma concentrations of the short chain fatty acids that elicit those healthful responses? So I think that we have to kind of be sure, you know, which aspect of the short chain fatty acids are actually creating those beneficial effects? Is it the ones in the gut that then, you know, signal down stream to other things that then regulate systemic health? Or is it a systemic, short chain fatty acid that actually pulls off the, you know, health benefit?

D Dr. Mike T Nelson 32:39

Yeah, so kind of, like, if you use a street analogy, like, which way is the street going?

Right, right, true, you know, and chances are, and, you know, sometimes I'm a big believer that is probably bi directional. Yep. But elucidating, that is going to take some time to, you know, get to those mechanisms. I mean, there's still just so many things out there that, you know, hasn't just been looked at in terms of who is doing what or who is where, in response to what kind of exercise I mean, largely, the exercise that's been looked at has been a lot of, you know, aerobics stuff, people are just starting now to publish other areas of resistance training and, you know, swimming as opposed to running or cycling as opposed to running. So I still think that there's some level of characterization that still has to occur within the exercise realm. That's not as well defined as as diet. So

D Dr. Mike T Nelson 33:34

yeah, and that's for context for people listening. Most of that is derived from just the equipment and stuff that we had to measure things. Right, if you'd look at a lot of the old school labs, it was a treadmill, and even back to like, when they had, you know, Douglas bags, or you're trying to, you know, collect expired gas. So we just, that was the only thing that was really investigated, because the tools at the time, was kind of the only thing you could really look at. And so now as technology is evolving, we've got other ways and other methods to to look at things we can look in different areas. But with you know, in academics, a lot of it is derived from certain labs have only historically looked at these things. And that that's just what we do in this lab. You know, sometimes trying to change the culture of it is a whole nother issue on top of it,

right, and then designing a study to look at things I mean, if you'd have to really sit down hard to look at how to best design say a resistance training study meant with a microbiome related outcome, right? There's then all those variables Okay, well, how many days a week and how do we break it up? Do you just want to look at lower body exercises upper body, chances are you need some combination of the both because a full body workout a little bit more equivalent to say in a row. bout and then do compare them and then okay, then we have to, okay, ours calories expended the same as total work done the same, you know, and, and I think these are some experimental designs that, you know, take a lot of time to employ. Yeah, recruiting as you say, you know, the air quotes like those, those are the, you know, human studies that, you know, take a lot of time and getting those people into the lab and making sure that they're recording things. And of course, since the microbiome has such a, you know, are so influenced by the diet, you know, either feeding them, which takes on a whole new level, right? Yep. Stick to a pretty regular diet throughout the time of the of the study, and really recording, that is another thing. So we start to add those layers of complexity. And I hope, you know, people who are listening can be like, Wow, okay, it's really not that just simple to take, you know, somebody and figure it out, you know, because you can certainly take, okay, these guys have been resistance training for five years versus aerobic training, and then, you know, get some poop and run some analysis. But the idea is also to understand though, how training influences the microbiota, so you'd want to not just engage in Okay, people who've been doing it, what are the differences? But what happens over time? Right, because those beneficial changes are what become important than for long term health, right?

D Dr. Mike T Nelson 36:32

Yeah, and I always think of, I think a lot of the publication and studies that are more rewarded are the more complicated ones. And I think that's great. But when it's a new area, I, I actually even like early pilot data to see does anything change? Right? So we have healthy people, we did X program of lifting and we gave them this diet? Is anything different? And that's not a really, as a sexy question as an intervention comparing the two things. But to me, that's almost more interesting. Because is it you want to know, is this really a thing? And then once it's a thing, then we can look at? Okay, well, how much of this is related to volume or upper body or lower body? Or are all the things you said to but the criticism of those studies, which rightfully so, is? Well, it's a pilot data, so your stats may not be the best. And who knows if the thing you

picked? is the thing that actually moves the needle, you could have maybe picked something else, and then it let it does. So you can drive yourself crazy, especially early on with all the, the what ifs, because you just don't have any data to base stuff on.

Right? Right. But, you know, to your point, though, science has to start somewhere. Right, right, that generates a few of those, what if kind of questions, then you at least know, you know, a, or at least have a start to avenues that you can pursue? You know, we always, sometimes the best science generates more questions that it than it answers, and I, you know, have found that that's been largely true. Yes. And you just kind of say, Okay, well, that's great that it generates these, which means we can say, you know, then how do you get the best bang for your buck throwing up, because science gets expensive quickly, when you start kind of pursuing those exciting areas?

D Dr. Mike T Nelson 38:31

Yeah, and I, the way technology is going to, you may be able to get samples from some earlier studies where they did an intervention. So I, for me, personally, I would love to see, and I know getting Bloods and poo and all that stuff is a whole different approval process and everything. But even if you don't have the budget, to do it, if you've got a really nice intervention trial set up, just get the samples and you can run them later if you have to, you know, because I think we're missing because the next question is going to be a mechanistic question. And you're probably going to need Bloods and samples to get at that level, and who knows what technology we'll have to look at a blood sample in 10 years from now. So I think just collecting those would be well worth the time and effort even if you don't have the funds to do much with them at that time, too.

Right? No, I I agree. And, you know, barring a massive minus 80 collapsing on those samples really do stay pretty stable over you know, and keeping them in there, you know, frozen, especially if you like you said design the study well to collect the samples in the appropriate way and at the the moment, where do you think it's, you know, the most beneficial then I, you know, I couldn't agree with you more that it's worth saving those and down the line when you eventually get the money because you Eventually, we'll it might not happen all at once. But you eventually kind of reached that point where, you know, you start getting funded for your stuff and being recognized. And that's where you're going to be thankful you save that stuff.

D Dr. Mike T Nelson 40:14

Yeah, because especially when you look at some of the older studies that have been done, like, it's almost impossible to think of all the questions that are going to come out of it, but we're getting to the point where we'll have things that we can then analyze to potentially answer them. Right. But if you don't have it, you can't look at it. So.

Right, exactly. And I mean, you know, trust me when I say, especially for collecting, you know, fecal samples, yeah, you have some of the fancy tools, but you know, that little plastic cup with the Super on the end of it, that they give you a doctor's office or, you know, even when you go to the you know, the vet, if you're your animal, and you have to collect things, I mean, those things cost like a buck believer, you know, and so splurging on on some of those just to, you know, then put them in a little cryo vial and get them in the freezer is is worth your while.

D Dr. Mike T Nelson 41:09

Yeah. And transition a little bit, we got about nine minutes or so here. I think you had some data about temperature differences, correct.

So we have some, you know, we have a model of initially started as longevity and enhance exercise tolerance that appears to work through brown adipose tissue. And so, I think that we know, brown adipose tissue is thermo regulatory through the uncoupling, you know, mechanism. And so, you know, we've been kind of tasked to take a look at if there's links between how the microbiota might be linked to the brown adipose tissue and its activity and metabolites that might be associated with that. So there's definitely evidence to suggest that the microbiota is you know, linked to, um, thermogenic capacity. So lack of a microbiota, and the ability to have cold tolerance, that that kind of data is out there. So we're just, you know, following up on some of that existing literature to find out in this animal model of enhanced brown adipose tissue of what's going on, microbiota look like, what are those metabolites look like? What does that transcriptome look like? And how do you start linking those together to Yes, regulate temperature,

D Dr. Mike T Nelson 42:46

though, is the proposed hypothesis right now that if you're doing say, cold water immersion or cold exposure, that that is then changing something in the gut microbiota, that is providing positive adaptations via changes in brown adipose tissue?

So in some ways, yep. That's, you know, that's exactly what some of the hypotheses are. And for a change, Mike Nelson, we have animals and there's a human study going on. Yeah. Eating. I have a meeting about that next week. So there's some there's some human aspects of that going on right now. And, and investigating, you know, what, are those microbes? How are they changing, and then trying to start again, linking that to, you know, other metabolites in both animals and humans, both in gut and you know, systemically or in animals, we can actually look at the metabolites in the brown adipose tissue that might be regulating that thermogenic potential.

D Dr. Mike T Nelson 43:53

Very cool. So do you think if you were to highly speculate that cold water immersion or exposure to different temperatures would be fine as a general term healthy, right, so if someone's looking to maximize health and longevity, do you think exposure to different temperatures would be something to consider doing?

You know, to me, if I had to be totally honest, I've never thought of it that way. Before? Um, because No, like cryo therapy kind of out there for recovery. Right, right. You know, exercise and or, you know, intense kind of things. Um, that's a good point, I mean, the the animal model, and this data is published so not saying anything to animal model we use that has enhanced thermogenic is a healthful living model. So it does live longer than its wild type littermates and does have this enhanced brown adipose tissue That is crazy sounds when actually is transplanted to its wild type littermates. The the the phenotype actually will translate.

D Dr. Mike T Nelson 45:11

Really? So basically in English it works if you try and work.

Yes, an English Yeah, if you give that, you know, special brown adipose tissue to it's the kind of wild type, which is the normal mouse right takes on the characteristics of the, you know, of the quote unquote special mouse.

D Dr. Mike T Nelson 45:31

And then, if you take the wild type mouse and do cold water immersion exposure to it, can it expand the brown adipose tissue in and of itself to reach the levels of the other mouse?

So it so it does it it does have an enhanced cold tolerance test as seen in the in the enhanced mouse? Yep.

D Dr. Mike T Nelson 45:52

Interesting. So the transplant, in essence is working to provide the thermogenic benefit, which is resulting in enhanced cold water benefit.

Yeah, as well as an enhanced exercise capacity. Hmm. Which is really, you know, quite interesting. So, you know, that's the the other, you know, aspects. And, of course, you know, we're messing around with the antibiotics and seeing what that done the microbiome and and I have to keep you posted on that, because we're still we're looking, we're currently looking at that data right now. Very cool. That's to keep you posted as to what happens with that. But yeah, there is that thatability aging into 2018. In aging cell, that paper on the RGS 14 came out. So that okay, was there? Yeah. For anyone who's interested? So? Yeah, it's interesting, you know, model. And so the idea is that we're going to replicate some of these transplantation studies and see, you know, if, because we've already, you know, looked at what special microbes are in this, you know, there you, you know, or in the special mouse. And then so, does it happen that when you transplant, the brown adipose tissue to these microbes kind of appear over time? Right. And then the flip side would be, you know, fecal transplant? So is it the brown adipose tissue driven? Or is it the microbiota driven? So we're gonna try and look at both avenues?

D Dr. Mike T Nelson 47:29

Oh, that's awesome. And my brain also goes to, hey, can we take a probiotic supplement? Before we do our cold water immersion to see, you know, greater upregulation? In brown adipose tissue? Right? Yeah, it would

we I think, in humans, like there's, there's some people who have brown adipose tissue, and it's overly active, and some people who really don't or have very little, and it's not very good. So you know, there's all these things in place to ensure that you have, you know, these brown adipose tissue, and then it's responsive and trying to get all that sorted out makes always experimental design. Interesting, right?

D Dr. Mike T Nelson 48:09

Yeah, my hypothesis, and there's a little bit of data support this in humans is that brown adipose tissue is very, very plastic. Meaning that if you're being exposed to cold water in a kind of use stress model, where you're adding a little bit, you know, time and time again, that it's going to expand just as a adaptation to to that. And if you just grab people off the street who generally live in thermoneutral conditions, you're probably not going to find a lot of it. So

right, right. Yeah. No, that doesn't, you know, that doesn't surprise me. The body is very interesting the way it works, right. When it has to adapt, it will. And that's what makes I think that's what makes our area so exciting to study, right?

D Dr. Mike T Nelson 48:52

Yes, yeah, definitely. Awesome. Well, thank you so much for all your time, and they give us a short plug for your program there. And if you're looking for any more graduate students and how people can find you,

yeah, sure. Thank you. Um, as you know, Mike said, I'm Sarah Campbell. I'm at Rutgers University in the exercise and gastro intestinal health lab. We are the Red Dragons so you can find us on Twitter and we're always looking for great people. So if you look up Sarah Campbell, Rutgers, you know, you can find my email address and don't ever hesitate to reach out even if you have a random question. I love answering those just as much.

D Dr. Mike T Nelson 49:35

So you the the Red Dragons now not the pool crew? Are you kind of both?

Oh, we've always been both but our true lab identity really that the kids are the Red Dragons and then you know, we're like, oh, they do the poo crew kind of stuff. It's kind of a your association.

D Dr. Mike T Nelson 49:55

Got it. Awesome. Well, thank you so much for all your time and thank you for doing mean all the work and all the research and managing all the studies and teaching on on top of that, and taking time to talk to us about like new stuff that is just on its way to being published and really appreciate it. It's awesome stuff. And I think we'll be learning a lot more in the future. So thank you for all the work.

Well, thank you for having me. It's always a pleasure to chat with you. We always come up with some exciting things to talk about.

D Dr. Mike T Nelson 50:25

Yeah. And it's easy for me just to sit here and lob crazy ideas at you. And you guys are the ones doing all the work.

Right, great. Well, you know, those kinds of things are the way you know, future experiments

get designed, right and where those ideas come from.

D Dr. Mike T Nelson 50:40

Yeah. Cool. Well, thank you so much. I really appreciate it. Anytime. Thank you so much for listening to the podcast. We really appreciate it. If you could help us out assuming you enjoyed this episode with brand new research. It's not even published yet from Dr. Sarah Campbell here by hitting the old subscribe button. And then you can leave us a review. Whatever stars you feel are appropriate. Make sure to read all the comments. And if you enjoyed this one, I'll share it with someone else, put it up online. Really appreciate it. Getting a science based approach for fitness to as many people as possible. And if you enjoy a science based approach, check out the flex diet cert. It opens again in January 2022 best place to get on the waitlist for it is Flex diet.com flxdt.com and you will be the first people to be notified once it is open again. Thank you so much for listening. I greatly appreciate it. Talk to you soon.