

# FD podcast Dr Sara Campbell

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[00:00:00] **Dr Mike T Nelson:** Welcome back to the Flex Diet podcast. I'm your host, Dr. Mike T. Nelson. On the podcast, we talk about all things to increase performance, better body composition, more muscle and strength, all done in a flexible fashion without destroying your health. Today on the podcast, we have back once again, my good friend, Dr.

[00:00:24] Sarah Campbell. And we are talking all about. The interaction between gut health and exercise performance. You may remember last time Dr. Sarah was on the podcast we talked about the potential role of antibiotics and how they could potentially affect your aerobic performance. We will link to an article that we did on that.

[00:00:53] And then today we expand on that a little bit. She has some great We talk all about hydration and gut microbiota, different types of water, how they could affect your microbiome. Also the oral microbiome, which is something people don't talk a whole lot about. If you are using something such as a mouthwash and a certain type of pre workout.

[00:01:21] That may ameliorate or get rid of the effect of the pre workout you were trying to do. Impact of other environmental factors fluoride and other things on the gut microbiota. Potential sex differences and some great new research. As you can probably tell, I am recording this from El Cuyo, Mexico. So there's a little bit of noise here in the background.

[00:01:47] We're hanging out here at Costa Chita. And kiteboarding, doing a bunch of work, it's been super fun. And in the process of getting down here, and also while we're down here, I brought a whole bunch of my favorite electrolyte supplement, which is LMNT, or known as Element. And you can check it out for yourself at the link which we will put in here.

[00:02:13] It's [drinklmnt.com](https://drinklmnt.com) forward slash Mike Nelson. Yes, it is an affiliate link. So I do make a little bit of coin off of it. I have used this one for, man, going on three and a half years now. And I absolutely love it. Especially being down here. We've been lucky. The temperature has been a little bit cooler, but on days it is warmer.

[00:02:34] I do sweat a ton. So being able to replace not only fluids, but electrolytes, especially higher sodium, which I know goes against a lot of things that are published. I found that it's been super beneficial overall, I feel like my energy level is much more consistent. My heart rate variability scores the next morning are also more consistent, showing that management of stress is also better.

[00:03:00] Check it out, the link there, they've got lots of wonderful flavors @drinkmmt.com/Mike Nelson. And then also we have the Flex four. This is four questions that are not published on the podcast, but you can get them via the link, mike t. Nelson. com forward slash flex for it's mike t. Nelson. com forward slash F L E X.

[00:03:23] The number four that'll put you on to the newsletter. And you'll also get a copy of all the most recent flex for questions. On this episode, it's actually the flex three. It's only have three big takeaways. But go there and you'll be able to get all those from Dr. Sarah Campbell also.

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[00:03:44] **Dr Mike T Nelson:** Welcome back to the Flex Diet Podcast. How are you today doc?

[00:03:48] **Dr Sara Campbell:** Hey, good to see you. I'm doing well.

[00:03:51] **Dr Mike T Nelson:** How are you? Yes, you're, we just mentioned you're surviving the finals as we're recording this right before Christmas during finals week.

[00:03:58] So I really appreciate all your time. So I know that's a hellacious hair pulling time of the year. It can

[00:04:05] **Dr Sara Campbell:** be quite and our university goes right up until the weekend before Christmas. It gets crazy, but you know what, you get used to it and you just, plan ahead and. Push through.

[00:04:17] **Dr Mike T Nelson:** Yeah, that's the one part I don't miss about for a while.

[00:04:21] The worst I ever did is I adjunct at four universities at once, but only three of them I was actively teaching. And I had to look ahead to see when all the finals would line up. And one of them, they overlapped the same weekend

only once. And that was horrible. I started 13 hours, all day, Saturday, all day, Sunday, you can't see straight after a while, but you're trying to make sure you're consistent of what you're doing and yeah, I don't miss that.

[00:04:50] **Dr Sara Campbell:** Yeah, it's good. We have to have our syllabus basically done before semester even starts. So Rutgers will actually have its final exam schedule up and published really early.

[00:05:01] Oh, nice. That's great. Yeah, you can plan. So by the time we get back from winter break in January, we'll know when the final exams are scheduled for May. So we can include that in our syllabus and kind of plan ahead. So with that regard, They're good about getting that stuff posted. So it's pretty

[00:05:16] **Dr Mike T Nelson:** transparent.

[00:05:17] Nice and you're leaving to go out of the country Correct. Yes.

[00:05:21] **Dr Sara Campbell:** Yes. My boys and I are adventurers and we did the Northern Lights in Norway last year.

[00:05:27] **Dr Mike T Nelson:** Oh, very cool. I bet that was awesome.

[00:05:30] **Dr Sara Campbell:** That was amazing. We had a wonderful time. And this year they decided to go south, but to like another continent. So we're going to go to Peru and do the Amazon, the Machu Picchu and the Sacred Valley kind of.

[00:05:44] Roam around Peru and just, have a good time and hang out for Christmas and so forth. Yeah,

[00:05:49] **Dr Mike T Nelson:** it'll be good. Oh, it'll be very fun and you can give me your nutrition perspective of all the different colored potatoes they have there. Yes. Which is amazing. Yes. A buddy of mine came back and I'm like, What?

[00:06:00] He's showing me all these pictures. I'm like, that's crazy. Yeah,

[00:06:04] **Dr Sara Campbell:** I'm very excited. We had our pre trip chat the other day and my one son is very picky. Very picky. And she's don't worry. They have more potatoes than you know what to do with. Okay, perfect. So good. So he should have something to eat everywhere we

[00:06:19] **Dr Mike T Nelson:** go.

[00:06:20] Nice. Yeah. So how long are you there for? Oh,

[00:06:23] **Dr Sara Campbell:** just about eight days. Okay, nice. It hasn't been too crazy, just enough to, get a feel for the, really fun places, and experience the culture and the food, and it'll be, starting summer, really, at that time, so it'll be warm, so it'll be a nice reprieve from the kind of old dry that we're in right now

[00:06:40] **Dr Mike T Nelson:** up here.

[00:06:41] Yeah, I've only heard good things about Peru. I haven't been there yet, but I've heard it's very pretty and just seen pictures, and everyone I know has been there, so they really enjoyed it.

[00:06:48] **Dr Sara Campbell:** Yeah, we're looking forward to it. When we were initially talking about it, that was one of the countries that came up almost immediately.

[00:06:55] They're just like, Oh, we highly suggest because you can do like the Amazon and the Machu Picchu, and it has the history and the rich, richness to it. So we're very

[00:07:03] **Dr Mike T Nelson:** excited. Very cool. And I sent you a crazy gut microbiome question before that. This is what's nice about having smart people in different areas.

[00:07:13] I can just send them my crazy wackadoo questions that I hear. And wonder about. But the question was that in the morning when you get up, you should rinse your mouth with water to transfer some of the bacteria from your mouth to your gut. And that was a gut health tip. And so I was just curious what you found on that, since obviously you do research on the effects of, different things related to the gut and exercise.

[00:07:39] **Dr Sara Campbell:** Yes, definitely. So I loved the question and it definitely got my, interest, PubMed juices flowing. I definitely plugged a few words into PubMed. I was like, Oh, how do I put that question into PubMed? So I started thinking of keywords, water, oral microbiome, gut microbiome transfer.

[00:07:59] And, there were several studies that came up. There, We've talked, before just about how most microbiomes maybe share a smidge in common, but

they're usually pretty unique to the environment. And as you can imagine, the oral and the gut microbiome maybe are a little more or have a little more in common than some of the other microbiomes.

[00:08:19] I was reading people were estimating anywhere upper thirties to maybe mid forty percent, of similar type microbes that you can find in the oral microbiota versus the gut microbiota. But unfortunately, there's really not much evidence to support that, those types of gut microbiota easily transfer from the oral cavity to the gut.

[00:08:43] There's more evidence that the bad ones might actually be somewhat influential. I found a few more papers in that area, but healthy wise, healthy gut microbiome, healthy gut. And, and oral integrities aren't really going to facilitate, this. Transfer now what is interesting is there's some Research starting to come out on the different types of water that you might take in and what effect it has on its microbiome tap water versus water versus bottled water And there does appear to be there's a paper that came out in the journal of nutrition in 2021 or 2022 that looked at the three different types of water and you know how that might contribute differently to gut microbiota compositions and just to think about, that aspect.

[00:09:37] So that was really fun to, to see and to bookmark so that I can read up on that and get a feel for what is there. There's also some, interesting studies that come out and more often than not what I noticed is a theme of, are there. toxicants or environmental things that you take in, through your mouth and then, does that impact the gut microbiota?

[00:10:02] And it does seem that there, there's some evidence there as well. So it seems to be that if everything is good and everything is healthy and you have a good gut barrier, Going on down there and a healthy oral cavity and the stomach is flowing and you have the low pH that there's very little that's able to get down just if you just wake up and you're healthy and you swig and hoping it goes down.

[00:10:25] But if there are pathogenic type microbes that, or you're taking in something toxic, for example, that might create a greater influence than some of the healthier things.

[00:10:37] **Dr Mike T Nelson:** Interesting. And in the water study, did you find anything about water, tap water we take we use a Berkey filter to filter our water because, I don't know, the water, at least where we live, scares me a little bit.

[00:10:51] We had a couple analysis done, I don't know how much I trust them. them because they're usually trying to sell whatever to disinfect it. So I take it with a grain of sand. But we did have the the company that's supposed to be doing all the water here in the city was fined for not being up to standards.

[00:11:07] And it was a huge public deal and the city is suing them. And yeah, so once we heard that we're like, Oh, I'm glad we're probably at least filtering it, but I don't know if it's good or bad or what your thoughts on that are.

[00:11:19] **Dr Sara Campbell:** So it is they had, they did have some interesting findings. I also remember now, giving a talk in New England ACSM around the same time and actually meeting one of the authors of this paper there.

[00:11:31] And we ended up having a long discussion about that, but it is in the journal of nutrition. I can always send you the link to share. That would be great, but definitely. So they definitely found a couple of really neat things. One that drinking water just in general, in, amounts that are recommended versus individuals who are low water drinkers does help to shape the microbiota differently.

[00:11:55] Staying hydrated is a good thing. microbiota they did note that there was Drinking differences in the type of water. Specifically, they mentioned, those who might be drinking water had higher, diversity in terms of Doria is one of the types of bacteria that are higher in well water drinkers and lower back to roids.

[00:12:21] All right. Adorabacter and streptococcus compared to the other groups, Drinking And like I said, they looked at bottled water, tap water filtered, and water were the three. And then again, there's just this very significant difference of gut microbiota between low water drinkers compared to, high water drinkers in terms of differences in what's down there.

[00:12:43] Just that, water should be accounted for when you're thinking about the gut microbiota and the type of water might make a difference and the amount of water is. Going to make a difference potentially as well. And those

[00:12:56] **Dr Mike T Nelson:** little bacteria they found, are those considered, my little air quotes here, the good guys or the bad guys, are they mixed?

[00:13:02] **Dr Sara Campbell:** That's always such a loaded question, because I know, right?

[00:13:05] **Dr Mike T Nelson:** I have to ask, because everyone's going to be like she didn't say if it was good or bad.

[00:13:08] **Dr Sara Campbell:** You hear Doria and typically you think of, yeah, that tends to be a more beneficial type bacteria.

[00:13:15] You think of things like streptococcus, and you're like, lower streptococcus. And you're like, oh, streptococcus. And probably the first thing you think of is, something more pathogenic. With just some of those. Few that were mentioned there. I'm sure there's more if I, dive deeper into the paper, which I haven't had a chance to do that.

[00:13:33] There's you probably do find, a tendency for the more commensal ones to be promoted by good drinking water and, less hydration. You can imagine, water being, it's going to be a good media for things like digestion and absorption and. Facilitating mucus turnover and maybe even influence pH and all of those things are known to affect the gut microbes that are going to be present.

[00:13:59] Depending on, if pH is higher or lower, that's going to influence the presence of those microbes and how water might influence that. But I think. I think it's a superb question. I think it's a really neat area. There weren't a lot of just plain water and gut microbiome studies, maybe just a handful.

[00:14:18] Like I said, more just putting things in water to see how the gut microbiota, changes. There's especially in the environmental toxicology realm, you think of things may be leaching into water and how that might impact things. Those are, some of the studies that I also came across and that things that you can imagine are toxic, have adverse effects on the gut microbiota.

[00:14:44] And so forth, but I don't know that if you're, you're thinking that you want to get up in the morning and swig something that is going to cause some, immense beneficial change to the gut that, if you're healthy in that realm, it's probably not going to do much, but if you do have maybe a pathogenic gut microbiota, or I'm sorry, an oral microbiota, due to.

[00:15:06] Things like gingivitis or, calcifications or anything like that, that might be harmful to the gut.

[00:15:15] **Dr Mike T Nelson:** Yeah, and that reminds me, years ago I did a presentation, actually I got a tryptic cancan out of the deal, which was great for a bunch of dentists. And I was just there giving a talk about body comp, and the

guy who brought me down was like most dentists probably need to hear this kind of information.

[00:15:31] I said, I don't know anything about dentistry. Whatever you guys are talking about I'm not the person for that. I talk about exercise and health stuff, he's oh, just give a talk on this, top three things for body comp. I'm like, great. And I get a trip to Cancun, all expenses paid for three days.

[00:15:44] He's yep. I'm like, I'm in. And so I'm hanging out at this conference with a bunch of dentists. And my first thought was Oh God, this is going to be so boring. And it turns out that dentists like to party. They're actually pretty crazy and fun. And then the second part I realized was, it was actually super interesting.

[00:16:03] They were talking about pH testing, they were talking about the mouth microbiome. This was like 12 years ago, about, should you brush your teeth? Shouldn't you? Are we changing the gut microbiome, biofilms, xylitol's impact on it? And it was actually really fascinating how there's some markers in.

[00:16:21] The oral health looking that are tied to cardiovascular disease, gut health. And that was actually super fascinating,

[00:16:27] **Dr Sara Campbell:** right? Great. I did. It's funny you say that because I did find, one study when looking and basically, how does fluoride exposure, change things.

[00:16:35] Cause you think about floor, water being fluoridated, to prevent tooth decay or cavities. And the idea is okay, does the presence of that fluoride alter something and in the microbiomes? There's definitely a lack of studies in that area and how, how that impacts things.

[00:16:54] That might just be another whole area in the whole water affecting oral and gut microbiota and what, other factors are going to have to consider, right? Is there fluoride in the water? And, I'd have to, like I said, to go back to that journal of nutrition paper, but, take a look at, did they measure what was in.

[00:17:12] The tap water versus the bottled water versus the well water versus the filtered water, are there, you have to be certain that water is going to come with, different, maybe micronutrients, then maybe bottled water or filtered water, or, somebody is saying, Oh, filtered water is going to get rid of all the bad stuff.



[00:17:31] And it's okay, what is, is that true? Do we have to look at that and think about how those might influence. You know the bugs

[00:17:38] **Dr Mike T Nelson:** and that gets into what kind of filter. What are you doing? All that kind of stuff is yeah, because for years I just use the standard not to rip on the Brita water pitcher filter.

[00:17:48] It's probably better than nothing. But when I actually looked into it, at least my back of the envelope stuff is oh, that actually doesn't remove a lot of stuff. It removes some stuff, but. Yeah,

[00:18:00] **Dr Sara Campbell:** Yeah. So water is a really interesting, field. I think most of us think at it, about it in terms of just hydration plans, at what point does, is water good, but a carbohydrate electrolyte beverages better.

[00:18:11] And that would come with its own set. And I didn't even go there, its own set of what is that due to the gut microbiota, the presence of these high yeah. Glycemic index carbs, the glucose versus the fructose, and the various electrolytes, and so that, that's a whole separate realm of things that would need to be looked into.

[00:18:31] Yeah,

[00:18:32] **Dr Mike T Nelson:** and how I ended up down the water rabbit hole was Just thinking about if someone does have a toxic load and you think about the volume of things they're going to consume day in and day out, water is, pretty high at the top of the list, so in theory, even if the amounts are small because they're consuming more volume, maybe that is, having some type of effect.

[00:18:53] Who knows?

[00:18:54] **Dr Sara Campbell:** So I was, like I said, I was looking at this, paper, let's see, I'm gonna go back to it because it was really interesting to talk about the amount of saliva that you produce in a day, cause you think about, oh my goodness, like that is, that's a lot of saliva.

[00:19:13] And, and that's being swallowed and there's lots of bacteria in all of that. And so it's just, hoping that you have this, intact. microbiota, and intestinal integrity that really influences, things in a positive direction rather than, that you have all these negative potential outcomes,

[00:19:37] **Dr Mike T Nelson:** yeah, it's just the more I study, even just health and exercise is the more you I always teach this to students too.

[00:19:42] It's if you're a good, robust, solid, healthy person, like most interventions, like homeostasis just ruins everything, and that's what you want. You don't want to be easily like, pushed over the edge because you ate a potato chip and had a reaction or to work. You know in a perfect world you want to not have things throw you off course,

[00:20:03] **Dr Sara Campbell:** And the idea is that again, while there might be some overlap between an oral and a gut microbiota You know the idea is those Microbes in a healthy gut microbiota are going to outcompete Anything that might come down orally because they're not really needed or, required for the function of the gut.

[00:20:26] They're more necessary for the function of the oral cavity, right? So in a healthy gut microbiota, the chances that those are going to have a significant impact is smaller and I just found that it's they estimate about 0.75 to about one and a half liters per day potentially of saliva production.

[00:20:43] Wow That's

[00:20:44] **Dr Mike T Nelson:** way higher than I would have guessed

[00:20:47] **Dr Sara Campbell:** It's much higher than I would have guessed too. There's this like I said, there's this really, fun. Article that has some of this information and I mean It's you know, just from recently that most of the articles that I found really delving into this are from 2019 forward.

[00:21:03] Really addressing this. The one, that I'm talking about is can the oral bacteria affect the microbiome of the gut? So it goes into all of these. Yeah, really? Thanks. I can, share that with you guys. Yeah, that'd be great. We'll put it as well. Just because it has some and it does highlight that there are some, commensal or pathogenic bacteria in the oral.

[00:21:22] microbiome that have been found in the gut microbiome. And it's funny you ask because there, there have definitely been some bugs that I know we've come across the, over the years of some of our studies, we're like, wow, that's an, that doesn't make sense. That seems to be a disease producing water that, that should be more common in the mouth than it is in the gut and it's popping up in the gut.

[00:21:45] So then, it starts to make me think and I'm like, maybe I need to go back to a bunch of this data and start but yeah, as you get questions and you and I interact and others interact and that's what the great part about science is and people who have areas and in, Or areas of expertise that are just not quite the same as they make you think of things that you normally wouldn't because you get stuck sometimes and you're like, Oh yeah, that is interesting.

[00:22:10] I should really go back and look at that. What is that gut, oral Mike microbe doing in the gut of my, mouse model, if I recall or try to recall, if, is it in a high fat diet? Because then you start thinking, okay, that might make a little sense, right? That, this high fat diet is.

[00:22:27] Pathogenic, we know, and is it possible that it's disrupting both microbiotas?

[00:22:33] **Dr Mike T Nelson:** Yeah, and I always think about studies that are, air quotes, easier to do and access. If you could go in it's much easier to get access to saliva than a lot of other things you might consider testing from.

[00:22:47] Just doing the process to having it analyzed to subject participation, all that kind of stuff,

[00:22:53] **Dr Sara Campbell:** Right and or, it's a very non invasive measure that could be easy to add to a study where you already have approval to get, say, serum and or fecal samples, you could always just do a little swab and or have a little spit go and save that in your minus 80 as well.

[00:23:12] And just when you're running and extracting DNA from all of these various sources, you just add that to it and, run it through. Microbiota, analysis is similar across, sites. So it's, it's the same process. You just delineate which site you're looking at.

[00:23:30] **Dr Mike T Nelson:** Yeah. And if it does hold some use, it's very easy to commercialize. And more people are probably going to do it then. Yes I've multiple times collected my own poo and put it in the fridge. It's all sealed and everything, but I don't tell my wife about it until after it's sent out for analysis.

[00:23:47] **Dr Sara Campbell:** You know where to send it. Just don't, you don't need to hide it. Just send it on to us.

[00:23:52] **Dr Mike T Nelson:** We'll let you know. I should start doing that more than

[00:23:54] **Dr Sara Campbell:** two. Yeah. Why not? Why not? We'll analyze it for you. But no, yeah, that's a, that's a good point is, like I said, especially if.

[00:24:02] They're concerned more on the disease side than the healthy side, we often talk I analyze lots of microbiomes all the time and I will admit still to this day I have yet to analyze mine. It's probably a nightmare even though I exercise and I eat well But you know with the whole gastritis and IBS and no gallbladder going on I'm sure that there's some interesting bugs that are down there, you know hanging out in causing a bunch of the stuff that I have going on, so you never know.

[00:24:33] **Dr Mike T Nelson:** Yeah, and last tip on the oral microbiome, for all the bros using their nitrate supplements don't use mouthwash at the same time. Because it'll obliterate the enzyme that you actually need to convert the nitrate into the active form, because that actually gets recirculated through the saliva. So I've I was telling someone else about that in the gym and they're like, I didn't know that.

[00:24:58] And it's like one of those things you pick up in research and you just assume everybody knows but then you talk to general population and it seems like Nobody knows, so I don't know. I feel like that needs to be an article or something.

[00:25:10] **Dr Sara Campbell:** But that's also a great point because I often remind, students going back to teaching that, in, in some ways, we're in a field and we can use language when we talk in classes and we talk to our colleagues.

[00:25:23] And, the general presumption is Oh, that's the common language, but we forget every science has its own language and that language is not universal. No, you just, you sometimes get so used to just presuming things and it's Oh, that's got to be translatable. That's got to be from bench to bedside.

[00:25:43] That's got to be out there in the world. Everybody can hopefully acquire some of that knowledge and use that to benefit them for their gains and everything else that, we're hoping to do and in our field.

[00:25:55] **Dr Mike T Nelson:** Yeah, totally. I heard you have got some new data coming out or at least some new stuff since.

[00:26:01] When's the last time we chatted on the podcast? A year and a half ago, maybe? Has it been that long? I don't know. A year ago? I'll put a link to it below. But it's been about a year maybe, I think.

[00:26:11] **Dr Sara Campbell:** Yeah, it's been a very busy and exciting Year, we've been collecting a lot of data and starting up some new studies and just getting some other ones You know finally often and published in the presses I think the last time we talked although now it's been published for a couple months We talked about the interesting antibiotic study in the nice where we noticed some changes in mitochondrial content of things related to oxidative phosphorylation and mitochondrial biogenesis, so a couple of things came of that, that, caused us to do a few things, we got asked about acute, right?

[00:26:49] Or control groups, does the microbiome change with antibiotics? Just, say you test the animal, you give them a week antibiotics and you just retest them. How does that do? So we did actually run and we just finished. A huge cohort of male and female mice where we tested them, gave them antibiotics a week later, retested them just to see what some of those differences are.

[00:27:10] So we have all of that muscle tissue in particular has been really exciting for us. And we we'll have plans to start analyzing that come the new year since we just finished that study. So it'll be an acute study because, we all know and exercise the acute and chronic effects and or Have you know, of exercise can be different.

[00:27:30] The hope is that an acute response will eventually become a chronic response, especially if it's beneficial. And the whole sex differences thing has just been really exciting to look at. We've also done some really neat things where, we talked about environmental toxicants.

[00:27:44] And so we looked at just air pollution, exposed mice and air exposed mice, so air would be the kind of normal control versus air pollution. And we definitely found some really interesting differences in. And acute and a chronic response. So we had, an acute exposure where they got a dose and then we looked at the microbiome hours later, and then a chronic dose, so over a period of six weeks.

[00:28:14] And, what you notice is that, within 24 hours, that microbiota shifts and it stays about, about similar for 48 hours, but it is distinctly. Different when you expose them to the, ozone, which is the air pollution versus the air. And then those responses are distinctly different from the six weeks responses.

[00:28:36] There's a whole shift in the communities with this chronic exposure to air pollution compared to what might happen in, in the first 24 to 48 hours.

[00:28:50] **Dr Mike T Nelson:** And is the air pollution there, are you using ozone or are you using particulates or what are you using for that?

[00:28:56] **Dr Sara Campbell:** So it's ozone and I'd have to go back and look at the exact dose and the parts per million and the kind of controlled environment and but we were, when we were talking about it with, not only our colleagues in toxicology, but, some of the colleagues and, the gut microbiome center that we work with.

[00:29:14] And, we ping and I were talking and he goes, this is just. Wow. He goes, we all expect that the hypothesis is, oh yeah, it should affect something, when you see it actually happening and then, this very distinct difference between this acute and chronic response, it's just okay, look, okay, we've got to get the metabolomic data now and then start integrating that because you can take the metabolomic data with the microbiome And start hopefully seeing what metabolites are being produced versus what microbes are there and start trying to make, association so that you can start looking at mechanisms does do these microbes actually contribute to the response you're seeing here in the, air pollution ozone versus that the air treated animals.

[00:30:01] That's been really interesting and something that we want to continue to look at, but we are doing a multi site trial with a collaborator, Dr. Chris Bell out at Colorado State. And we're translating we talked. I know you've been, asking me is like, when are you going to do this?

[00:30:19] I know it's a lot easier said than done. And it is definitely a lot easier said than done. But we have, done our due diligence and got IRB in. We got our reapproval because the studies. been going on for several months now. As you can imagine, we're trying to aim for 20 participants per site.

[00:30:38] So 40 participants, but male and female. So we'll have a nice sex difference to look at. But basically, yeah, translating are hoping to translate, I should say, some of our animal findings, as a preliminary study, you can't just go in right away because it's expensive and you need people and just take muscle biopsies and start running all of these things.

[00:30:59] But we are just, taking a look at we're starting with trained individuals because the idea is does this antibiotic disrupt, training and trained individuals because that's what the animal study, show that we trained the

animals then gave them the antibiotic and had them continue training and see what the outcome is.

[00:31:18] So untrained individuals, probably a whole separate story, but to translate, that's what we figured. And we wanted to take out the confounding variable of illness. Because a lot of times you get an antibiotic because you're not feeling well, and it's okay, are you not exercising because you don't really feel great?

[00:31:35] Or, you're using the antibiotic. So we're Giving, healthy participants just a D Pak, and so nothing too Zithromycin, is that right? Yeah, sorry, Zithromycin. So nothing too crazy, but it's one of the more commonly prescribed medications, especially for athletes. So we figured, you know what, that's a great place to start.

[00:31:55] And we figure it's win either way, as crazy as that sounds. If it shows that there's an effect. It's okay when we need to start thinking about how long that effect may be persist for and advising athletes properly. But the flip side is, if it doesn't necessarily show changes to performance, then we can say, okay, it's maybe the illness that impacts the performance and not necessarily the Z Pak or the antibiotics.

[00:32:21] Might just be best to take your antibiotics, let it let the colds pass itself over. And see what happens. But so so hopefully by the end of our what would be our spring semester, since it seems that both of our sites are close to or halfway done with the participant collection. So if anybody is local, we're in Jersey, reach out, still looking for participants are in your the Fort Collins area, reach out to Dr Bell because, we'd love to have you in the study And, just start understanding the human side of things.

[00:32:55] The animal side is fun because you can collect all the tissues in the world you want and run, a bunch of mechanistic, molecular biology, type assays. But ultimately, we want to understand how it translates to human performance and do we see similar things? The hope is we get this study up and running and it produces some cool data and we, are able to use that to fund bigger ideas and bigger projects where we can maybe do a biopsy and see what's going on in, in the muscle and the mitochondria.

[00:33:24] Yeah,

[00:33:24] **Dr Mike T Nelson:** It's super cool because like we talked about last time is I'm you know, I must say I'm not against animal research There's a good

place for it You can do a lot of mechanistic stuff, but it just feels like to me, especially more as an outsider with academics the whole Premises you need to publish you need to get research out and a lot of times it's easier to just extend That animal research into more and more mice and get hyper mechanistic without knowing does this transfer?

[00:33:54] Humans or not so CLA is a, the sports supplement is like my pet peeve for that because it's freaking, amazing in mice and we have multiple human subjects trials now done from multiple different universities that shows it does basically jack squat in humans. But yeah, they keep running more mice experiments on it.

[00:34:13] Like we need to have the jacked mice running around everywhere. And I get why it's done. It's just. To me, as someone who's trying to be practical it annoys me.

[00:34:21] **Dr Sara Campbell:** No, and you know what? I can understand. And, initially, we can look at, things, getting a blood sample to analyze serum metabolomics, having them bring in a fecal sample well timed within their last exercise session before they're taking their antibiotics.

[00:34:37] But within 24 hours post of their animal, and in when we, you do that, nice and timed and plans, you can get some great, we're going to get fecal Michael Briota profile analysis. And again, between the sexes, which is great because if there's a sex difference, that would be really interesting to start to elucidate.

[00:34:56] We can get, fecal metabolomics as well as serum metabolomics to see if there's a difference. Before and answer after the antibiotic use and what that might mean for metabolic pathways. And we can get performance data, things, we're doing VO twos, we're doing time trials.

[00:35:13] So we get a variety of measurements in these participants in terms of performance, mechanistically. We're going to need that data if we want to rationalize how we might, get a muscle biopsy sample or, take things a little, further with looking at additional, if you wanted to do some like tracer type studies where you really look at metabolic fates and so on and so forth.

[00:35:37] But I think this is a fun first step and, obviously a great project for, a doctoral student and my student did get a grant on. Nice, that's awesome. Yeah, so he can conduct this research and the team's just been really excited about that and the other projects we have going on.



[00:35:54] Yeah. Yeah.

[00:35:55] **Dr Mike T Nelson:** It'll be fun. And it's super cool that you're doing that because it's a cool question, especially when you see the animal data, which your lab has published, it makes you go, oh. Shit, is this something like, especially as a practitioner, is this something that I'm missing? Like we talked about it, it's so hard to even get anecdotal information because almost all the time they're on it is because of some illness, which they know is going to wreck the immune system, is going to drop performance.

[00:36:19] And then I consulted with you, I had the one client who had a dog bite during her training and got prescribed antibiotics, so we had her. Do a bunch of max tests and a bunch of other heinous shit to see if there was any difference. Cause to me, I'm like, Oh, this is a perfect case study. It's a human. She got antibiotics, but it wasn't because she was sick.

[00:36:40] So I was like, Ooh, I was all excited.

[00:36:42] **Dr Sara Campbell:** No. And it is really cool. And the other thing that's interesting is you start compounding it because not only is there an acute versus chronic, but there's the trained versus untrained response. So Would it be similar in a trained individual as an untrained individual?

[00:36:59] We talked about the results of the case study and, in some ways, we can say, okay that person knows what they have to do. They're used to training. You think of elite athletes, they really push through anything with very little differences in performance.

[00:37:16] So would a little, I hate to say little, I don't mean to say it like that. Would an antibiotic actually influence performance? Maybe not, but does it, it doesn't necessarily mean it's not going to alter the microbiome profile or maybe even the metabolomic profile and that could be equally as novel and exciting to find out as opposed to, someone who might be untrained and have a completely different response to that, acute antibiotic, so there's the whole series of questions and studies you can get into.

[00:37:52] Looking at, again, acute versus chronic versus trained versus untrained. And even, severity of an, and probably severity is not the right word to look for, but, various classes of antibiotics, the Z-Pak is, or the Azithromycin is somewhat. Mild for lack of a better word, somebody who's going to listen to this and be like, shouldn't know what you're talking about.

[00:38:15] And I don't know the right word to use, you start comparing that with, something meant for Mercer or very strong and powerful. That is really going to. Maybe knock out more of, both the grand negatives and the grand positives and so on and so forth.

[00:38:31] There's always the, the spectrum of antibiotics and how severe that's going to influence the microbiota and thus performance. Because athletes are not just going to be put on, say the azithromycin, they might have to be put on something else. If something, more severe comes up requiring, a greater intervention. There's lots of fun questions. That sounds sick, but, there's a lot of, really interesting questions across this, initial study that can, take us in a variety of directions that might provide some insight for, those exercisers.

[00:39:05] **Dr Mike T Nelson:** Yeah. And I think of higher level athletes as humans who are just really good at compensating, right? They can just return back to baseline so much faster. I mean I was unbiased of the whole physiologic flexibility course of how do you train that in people once you've got the basics down and stuff like that.

[00:39:22] But I'm always super curious to see it'd be, to me, it'd be fascinating if it did alter the microbiome significantly, but did not alter their performance, right? Cause then it's Oh,

[00:39:34] **Dr Sara Campbell:** what the hell's going on? And of course that's, of course that's an option. It's interesting.

[00:39:39] I'm certain, that. During the the max test and the time trials. They've got heart rate monitor. So we'll be seeing heart rate, looking at RPE, does, is that RPE different? Is it possible that? Yeah, they feel like it's harder, but they're still doing it and achieving the same goal because they're used to having to do that.

[00:40:00] Because they're trained and if they're used to racing and having to run lots of, miles per week, they might just say, okay this is just something I, I have to do and it, like I said, trained, untrained, amateur, elite, super elite. It, there's a whole bunch of really fun questions you can ask just with some of these more, simple for lack of a better word, experimental designs to, to, characterize things across that continuum.

[00:40:26] **Dr Mike T Nelson:** Yeah. And are they using a metabolic cart when they do the exercise portions? Yes. Nice. Yeah. Yeah.

[00:40:32] **Dr Sara Campbell:** All of that data to to RER. Nice.

[00:40:36] **Dr Mike T Nelson:** Yes. Yeah. Cause then I start wondering now you can look to see if their performance was the same. Was there something different? Did they shift to using carbohydrates sooner?

[00:40:47] Did their breath rate go up? Did their volumes change? And if that's consistent with everyone. Then it's Oh, wow. So there, there was maybe a physiologic change, but they were able to compensate and to hold performance. So I don't know that kind of stuff. I always find fascinating. Yeah,

[00:41:03] **Dr Sara Campbell:** And it is true, right?

[00:41:04] And you think, and I, then you start thinking, okay we're getting serum metabolites, right? So if they do hit a higher RER sooner, is that going to be reflected in their metabolites, right? Are we going to see a different propensity for something to show up versus this pathway to show up? For as I hate to say bare bones is, but for, as an initial study, we were very careful, as most researchers have to be with those preliminary studies to be like, okay, where do you get your biggest bang for your buck?

[00:41:35] We don't, we have money, but it's not a ton of money yet for these studies. So what are the best things to do? And it's okay, get some blood, get some, fecal samples, do your time trial, do your VO two max, we're doing a body composition. We've been standardizing the meal before every, so they're getting this, everybody's getting the same kind of Bar and drink before they do their trial.

[00:41:58] So we're trying to account for as much as possible, with this preliminary study. And so the hope is that because we're, again, accounting for some of these things and measuring the performance outcomes as well as using the metabolic heart and, bod pod data integrated with maybe the serum and or fecal microbiome, there's going to be some fun things we can see there.

[00:42:23] **Dr Mike T Nelson:** Yeah, and that's what I, obviously I'm biased in my research was using metabolic hearts. I freaking have one in my house to play with and shit, but just even if it's just the output is the main driver, if you have the metabolic heart and you use it, it gives you that next level down because if there is a change, as you well know, The next question is how the hell did they do it?

[00:42:44] And if you've got volumes, you've got oxygen, you've got carbon dioxide, they're already on the damn thing doing a max exercise test anyway. It's just like getting all those other little things that, yes, I know it's a convenience. Yes, I know it's a cost. People don't like the mask. I get it. But I think there's some trade offs that are worth it.

[00:43:00] Because if you think forward, To what could potentially happen, you will potentially have collected the data to answer it, or getting bloods, or stuff like that, even if you just freeze it, you don't have the budget to run it, for God's sake, if you can collect it, and you can get it approved, please collect it, and I know it's easy for you to say, sitting on my ass, not doing this, but.

[00:43:20] Yeah,

[00:43:21] **Dr Sara Campbell:** and that's, that's what that's what we say about really. It's planning ahead and it's okay we're getting all of these fecal samples and you get a lot of, blood from human participants as opposed to mice where, you really have to, you really have to budget your blood work with, a mouse, whereas you, and it's okay what do I do?

[00:43:39] And I'm like, minimum five, two ML,

[00:43:43] **Dr Mike T Nelson:** Nope. I think it froze for just a sec there. Maybe it's. My internet. Oh, you're back. You said good five. Sorry, my

[00:43:49] **Dr Sara Campbell:** bad. That's all right Somebody's walking around but five five for fecal samples five, you know So right now I can only think of two, you know use two Fecal samples for one for microbiome one for metabolomics That means I have three left over in case I want to do anything else, right?

[00:44:05] Five things for serum and you defrost one two ml And you've prepared everything you need you aliquot a bit to go off to metabolomics And the rest of it, kids are getting to the point where you need 10, 20, 30 microliters for well, you can run in one. And so I've got, four still leftover two ML two was full of plasma to be like, Oh okay.

[00:44:29] That say amino acid pathway seemed to be off. What else can we measure? In another, using another one of our aliquots to do this or that. So as you said, we're, we have definitely, what we'll have many of our little boxes in the freezers, but it will be full of samples for, I should say when, not if, but when.

[00:44:49] We find some cool things and we start wanting to move forward with some additional studies and mechanisms and back to your metabolic heart thing. You can do things like calculate V max and, ventilatory thresholds and, all of that other stuff to see if, and when that kind of thing changes.

[00:45:05] We're very excited about this study.

[00:45:08] **Dr Mike T Nelson:** Yeah, I remember at, I won't say what university, but people could probably figure it out. But we had a, they had to move the SubAV freezer and because they found out it wasn't on a backup power generator. And I remember in the meeting going, say what?

[00:45:25] You have a freezer that has samples going back for almost two decades now and you do not have this thing. On a backup, and luckily it was one of their small freezers, it wasn't one of their main ones or anything like that. And I'm just sitting there thinking, Oh my god, like the amount of data, and if you were to rerun those experiments, like the cost, and like how much stuff you were potentially losing, and they got it all fixed.

[00:45:51] It worked out fine, everything was good. But in their head, they're like we already did, the experiments, we published the stuff we want and I'm like, yeah, but you don't know what testing you're going to have in the future. You don't know what questions you're going to have. And you've published, you ran the human stuff, you have all the, you have the hard part done.

[00:46:12] **Dr Sara Campbell:** And it does. And I think that's, And to your point, through our previous conversations and actually, it's the same thing when you run an animal study, you want to take all of the tissue you possibly can, think about it. Same thing with the human study.

[00:46:25] You want to get enough and think far enough ahead to aliquot enough of your things. Aside just because you never know what you're going to find and that sometimes that's the fun thing with science, right? You have your hypotheses, they might not always come true or they might come true in an awkward way or they don't come true when in an interesting but good way or they don't and they fail completely, which is a lot of times what happens as well.

[00:46:52] But nonetheless, planning ahead is probably You know, the best thing a researcher can do, ensuring that experimental design is answering the questions or at least attempting to answer the questions that you're looking at in

a complete as possible way. , it, it really stinks after the fact when you try and publish something and they're like, you didn't think that through at all.

[00:47:18] I definitely pride myself on, when reviewers are just like, this was a very well thought out. Experimental designs. Yes. Yes.

[00:47:28] **Dr Mike T Nelson:** Thank you. Yeah. ,

[00:47:30] **Dr Sara Campbell:** You have faith in my results. That's awesome. That, that is. Sometimes, one of the best compliments you can get, from reviewers is that's a good experimental design.

[00:47:39] Okay. That means I took the time and thought really hard about appropriate controls and, putting things in place. And so that's really

[00:47:48] **Dr Mike T Nelson:** important. Yeah. And doing peer reviews, it also just breaks my heart when I have to I rarely will put not accept, like I'll give them every chance possible to explain it, to rework it.

[00:47:59] If the method section is valid, if your method section is fucked, you can't unfuck the study. If you didn't do a bunch of major things, like there's nothing unfortunately you can do to normally save it at that point, so it's just consult someone else, just do whatever you can to make sure your method section is solid and maybe the execution got screwed up or wasn't under your control or whatever but to me that's like directly under your control because you're the one writing it and it just kills me to see people put time and effort into something where you're like I, I can't pass this because it's just, it's up I'm sorry.

[00:48:40] **Dr Sara Campbell:** Yes, it has the fatal flaw as it's like the death, but I agree. I usually try and give, folks a chance to revise and submit and at least, answer concerns because sometimes there could be very valid ones. And, a good example of that is, we, fortunately, unfortunately had to use just only male mice for that.

[00:49:02] Study that we, published with the mitochondria and, the question was like, why? And it's the female mice were actually being used for another aspect of another study and you just didn't, weren't able to get use out of both sexes in that case, which is a bummer, that's the transparent truth.

[00:49:19] And then it's you know what, fine, I don't have any problem putting that in as. A limitation or at least addressing that it was like at the time that, the female mice in the cohort were just being used for another aspect of another

study and that's just the truth and the reality of the matter, do we make every attempt to put, both sexes in as often as we can?

[00:49:40] Absolutely. Because the sex differences have been really exciting and. Worth investigating beyond anything. It's been really exciting, some of the sex differences things we're finding,

[00:49:50] **Dr Mike T Nelson:** yeah, and that's my pet peeve of some armchair critics online, because you put out a study and there'll be a laundry list of people that are like, oh, but you didn't do this, you didn't do that.

[00:50:00] I'm like, hey, knucklehead, how about you ask the researcher why they didn't do it? I can guarantee almost like 90 percent of the time there's a good reason it was done that way. Maybe it didn't show up in the paper. Maybe there's a limitation. Maybe it didn't make the limit section. Whatever. A handful of times I've, followed up with them, same thing.

[00:50:17] Oh, this is being used for another experiment. Yeah, we thought of it, but we couldn't do it because of this and because of that. Or you're like, oh, okay, cool. That makes sense.

[00:50:25] **Dr Sara Campbell:** Agreed. And you know what? Sometimes you'll often find that, money is a factor that plays into, science.

[00:50:31] Science is not cheap by any stretch of the imagination. You know, you find a kit you're, you're or an antibody and some of them can run you five, six, 700 a kit or an antibody and you have to appropriately power a study and then you have to run those things and duplicate or even triplicate.

[00:50:52] So now you're looking at, for a 40, say, mouse study that's appropriately powered and you're looking at, say, just five markers. At 500 a kit, just even arbitrarily, let's make it easy, but you need, cause there's 40 animals times nine, times this many time points, at least a pre and a post times three wells that you need to use.

[00:51:16] Cause you'll run it in triplicate. You start adding that up and you only get 96 less than that, because your first two columns in a plate, you have to run your standards and your controls. And so now you start running, you're like, okay, that's two or three kits. So that's 1, 500 times five markers. Things start adding up real quick.

[00:51:35] And that doesn't even for animals account for what you have to pay for them every day, the specialized food that you want to feed them because you want to make sure their diet is well controlled for and all of these other things, humans are the same way. It's a lot of times. Paying for the space that you're testing them in, because if that doesn't come for free, like most people might think, there's the space with all of this, expensive equipment you've either paid for upfront. Metabolic carts run what? 30, 40, 000 now just for metabolic cart. Talking about right. Some of the other measurements. I would agree. I think there's a lot of things that. Or they're typically as a rationale for why researchers, pick and choose the things that they have to pick and choose and asking them.

[00:52:21] Is always a good thing and rather than assuming that we didn't know any

[00:52:25] **Dr Mike T Nelson:** better Yeah, and even when you're doing human subjects like one of the issues I ran into is okay Yeah, I would love another group and one of the energy drink studies I did but shit That means they got to come into the lab and do max tests four times because i've got a baseline I've got a placebo and i've got an intervention But if I want to add another intervention, that means another trial.

[00:52:45] I'm not paying these poor people I'm, just trying to get together whoever I can scrape to get in to do the study that meets the qualifications. And then if they drop out of one of those trials, I can't really use that data because it's randomized. I don't know what freaking group they were in.

[00:52:59] So that means that scratched one person, which drops my power, which now I might be completely off to not even be able to publish the study because I didn't get to the power. And, all these things you're like juggling in your head because I'm going, Oh my God, I got to graduate. I got to publish this thing.

[00:53:13] I can't not publish it.

[00:53:15] **Dr Sara Campbell:** No, and it's true. And you do have to consider, what the participants are doing to help you to not just your science, but the science of the field. And like you said, A lot of times, especially as a doctoral student, you, you don't have the money to pay these participants.

[00:53:33] You just ask them the kindness of your heart. You're a runner. Don't you want to know this stuff about yourself? And that's how you pitch it. You



might not get paid, but you're going to know what your VO<sub>2</sub> is and your body composition. And. Some people that's totally enough for, and believe it or not, a lot of people because they understand, but at the same time hope to want to compensate your participants to as best you can just for their time.

[00:53:55] But it is demanding and for max test. That's a lot to

[00:53:59] **Dr Mike T Nelson:** ask. Yeah. Yeah. So that's why I dropped it to three. And yeah, same thing. It's like I was buying energy drinks out of my own pocket at the grocery store because I had no money to run the test. And then. You try to find people that are interested in and I also tried to make it a big deal that they were doing me a very good personal favor, which was 100 percent true, right?

[00:54:21] So it's there's certainly not money that's keeping them to do this. So if I can make them feel like it's. I'm forever grateful for their participation again, 100 percent true, then hopefully when it comes time for the third max test, they'll show up at five in the morning.

[00:54:35] **Dr Sara Campbell:** Because you need to control for their circadian rhythm, right? And run the test at the exact same time. The number of things that you like, have to consider, holy moly. Yeah. It just, the laundry list gets quite long sometimes.

[00:54:48] **Dr Mike T Nelson:** Yeah. And you're talking about setting up experiments and.

[00:54:51] I don't know who I stole this from, but one of the phrases that people think that it's Eureka is like when you have a big breakthrough and they're like, it's actually when someone in the lab goes, Oh, that's funny. Like things don't line up the way that they're supposed to. That's usually like the bigger breakthroughs of, or what you've, you find out at that point too.

[00:55:14] **Dr Sara Campbell:** Because science requires a lot of patience too.

[00:55:17] **Dr Mike T Nelson:** Yes. Yes.

[00:55:19] **Dr Sara Campbell:** Yeah, we're excited. It'll be good. It'll I think that we're like I said, I think this first study we've attempted to just plan and trying to control for what we can and check off enough really cool boxes to get us some fun data to start with and hopefully work down this human translational

route where we can ask some of those more mechanistic questions later on once we've got some of this data.

[00:55:44] **Dr Mike T Nelson:** Yeah. And last question as we wrap up any thoughts about some of the consumer grade gut microbiome testing that's out there? I know we touched on this last time a little bit, and I'm not talking about the ones that you can do through your physician or your doctor or that, have some actual data behind it, but it just seems Every time I'm on Instagram, or, I don't know, maybe it's because of the research papers I've been pulling, I don't know, like a new gut biome test pops up for 100, 200, and it appears to tell me everything I can do with my nutrition, down to, I guess I just need 3 carrots a day, and I'm like, good to go.

[00:56:18] It just seems very translated and hyper specific. It's not just telling me, hey, we found these things in your gut, here's the data, what it might be related to. It appears to be hyper, hyper specific to give me all the answers, which I have my doubts about right?

[00:56:36] **Dr Sara Campbell:** The interesting, if, they're always willing to share the interesting thing would be to how are they or what are they using to run?

[00:56:45] Their analysis, do they use a particular platform or are they using a particular extraction technique and or what region of the variable are they looking at? How many base pairs are they getting and they, if it's a shorter read, versus a longer read where you can match more of the sequence to.

[00:57:07] Your databases and so forth. Same thing with the, the metabolomics are, what kind of, are they getting positive? Are they getting negative ionizations? Are they getting the polar versus the nonpolar? And, the polar being the carbs and the proteins, the nonpolar being the lipids, which is.

[00:57:24] In and of itself, we know two to three times more expensive because of the technique that's required to, to get those, fatty acid profiles done. So having an understanding of the platforms and the techniques they're using, you hate to boil something down to, if it seems too good to be true, right?

[00:57:44] I know. It may be is, but, understanding all of that and, something for one or 200. Just knowing what it typically costs to run all of these analyses just seems like a really low price to run such a comprehensive profile. I also am not quite sure how far along the mechanistic analysis or the tools.

[00:58:12] I should say, how do I say this, the tools we have are getting better, but I don't know if they exist to the point where you can get at that level of a mechanism just yet. I think if we were at that level of mechanism, science would have produced something already microbiome related that's, rather, treatment oriented.

[00:58:38] Yeah. And, while we do talk about, things like the FDA, approving FMTs or fecal transplants for things like C diff, and the, probiotics that are out there that we can argue. How beneficial or not beneficial are they, we really don't see overt gut microbiota based therapies for a variety of diseases.

[00:59:05] There are things that we talk about in terms of dietary modifications that can elicit changes to the microbiota that are beneficial for metabolic based diseases. There are calls for the NIH for things like bugs as drugs, from the Cancer Institute. So I think the desire is there to try and understand this.

[00:59:25] But I don't know how I'm sure we're close. I'm sure there are researchers who are far closer than me and knocking on doors and so forth. But I don't know if that's commercially available.

[00:59:39] **Dr Mike T Nelson:** Yeah, because the other part that I know what the better test costs even to like a health care provider.

[00:59:47] And I know what research has gone into it from talking to him. And I know also what level of detail they will report. And if they believe they had enough data to make it more granular, it would be 1, 000 percent in their advantage to do but they stop with what the limits of the current data is.

[01:00:05] And that's not as specific as a 200 test you buy off the internet. Makes me go, and the more expensive test is 4 times as much. Yeah, I know. I agree. You don't want to, it sounds too good to be true, but yeah, and it doesn't mean we might never get there. We're probably going to get there at some point.

[01:00:27] It's just, I don't know. And if it worked, like I'd be the first person in line to buy it. I'd be running on every client I have right now. But yeah, I, one of those things I wish were true, but I just, I can't sign off on it yet personally, but I'm always curious what the actual experts think too,

[01:00:43] **Dr Sara Campbell:** yeah, I, like I, yeah, I would say probably not something to sign off on, just yet, until you know actually what techniques And machines and or methods they're using to do that. And if that matches what is

known in the scientific literature that we validated, and if it, how well that matches up and what they're promising.

[01:01:04] **Dr Mike T Nelson:** Yeah. Awesome. Thank you so much for all your time. Really appreciate it. And if people want to help out with one of your studies or I don't know if you're considering any graduate students for next year or how would people get a hold of you or find out more from you?

[01:01:19] Yeah,

[01:01:19] **Dr Sara Campbell:** so we're always looking for, fun, motivated students and, or participants and. I'm at sarahcamp at kines. ruckers. edu or you can just, Google Sarah Campbell Ruckers Kinesiology and, I'll pop right up. Hopefully. I don't know any Sarah Campbell, other Sarah Campbell's at Ruckers and Kinesiology.

[01:01:40] And yeah, just email is usually a really good way. I'm super responsive and, don't hesitate to reach out.

[01:01:46] **Dr Mike T Nelson:** Awesome. Thank you so much. And thank you for all your great research. And once the. Human subjects trial is done. We'll have you back on to discuss that. I'm super excited to hear how that goes down.

[01:01:57] **Dr Sara Campbell:** Yes. Thank you as always for having me. It's always great talking to you and I will definitely share those results with you as soon as they're hot off the press for sure.

[01:02:05] **Dr Mike T Nelson:** Awesome. Thank you so much. Really appreciate it. Have a good one. Thanks.

[01:02:09]

[01:02:10] **Dr Mike T Nelson:** So huge thanks to Dr.

[01:02:10] Sarah Campbell for being on the podcast. This is some up to date research. Some of this hasn't even been published yet or is just in the process of being published. So enjoy this podcast. Thank you so much. Thank you so much for listening to the podcast. Really appreciate it. Huge thanks to Dr. Sarah Campbell for coming on the podcast again.

[01:02:33] All the wonderful research of who and her lab crew are doing wonderful stuff. And it's always cool to talk to friends doing research and to get

the latest and greatest and be able to pass it on to you to help increase your health, add some more muscle strength and improve your body composition. If you want to know her top three takeaways.

[01:02:57] Go to [MikeTNelson.com](https://miketnelson.com) forward slash flex 4. That's F L E X, the number 4. Yes, I know I only got 3 this time, but normally I have 4. And you'll be able to get a link with those exclusively sent over to you. If you're already on the newsletter list, they will be sent out to you automatically. If you're looking for a great electrolyte supplement, check out LMNT.

[01:03:22] Go to [DrinkLMNT.com](https://drinklmnt.com) forward slash Mike Nelson. I brought a whole bunch of those down to Mexico here where we're at for another week. Hanging out, doing some work, bunch of writing for a couple of books and also doing kite boarding when it's windy. So check that out and go to [drinklmnt.com](https://drinklmnt.com).

[01:03:41] [miketnelson.com](https://miketnelson.com) forward slash Mike Nelson. As always, so much for listening to the podcast. Really appreciate it. If you have time to give us a few stars that you feel are appropriate or even better. Write us a short review that goes a long way to helping us with distribution of the podcast. There's a whole bunch of podcasts out there and that really does help us out.

[01:04:05] Someone you think may be interested, please forward this podcast to them. Share it online. Make sure to tag me so I can say thank you so much. Thank you once again for listening to the podcast. Really appreciate it. Talk to all of you next week.

[01:04:21] What do you suppose they call that? A novelty act? I don't know, but it wasn't too bad. Well, that's a novelty.

[01:04:30] **Nancy:** This podcast is for informational purposes only. The podcast is not intended as a substitute for professional medical advice, diagnosis, or treatment. You should not use the information on the podcast for diagnosing or treating a health problem or disease or prescribing any medication or other treatment.

[01:04:46] Always seek the advice of your physician or other qualified health provider before taking any medication or nutritional, supplement, and with any questions you may have regarding a medical condition. Never disregard professional medical advice or delay in seeking it because of something you have heard on this or any other podcast.

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[01:05:37] If you think you have a medical problem, consult a licensed physician.

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