All About Collagen Protein

Mon, 11/1 10:46AM 1:15:13

SUMMARY KEYWORDS

collagen, study, people, potentially, grams, supplement, glycine, tissue, benefits, research, bdnf, literature, looked, exercise, pretty, protein, peptides, interesting, question, bit

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Welcome back to the flex diet podcast. I'm your host, Dr. Mike T. Nelson, where we talk about everything here to increase your fitness performance, and better body composition, all without destroying your health in a flexible system. And today, I've got a great researcher. And we're talking all about collagen. Now you may think collagen, isn't that just a horrible low grade protein doesn't do anything to help muscle repair who gives a crap. And that's kind of what I thought as of about five years ago. Then I started reading some research around that time a little bit after from Dr. Keith bars lab, looking at collagen may be useful for soft tissue recovery. And then a may have lots of other benefits too. So it was at the International Society of sports nutrition. And the researcher here, gave a great talk on a brand new study that she did regarding collagen. And it had some pretty positive results and the dosing was quite small. So I talked to her afterwards and was able to twist her arm in get her on the podcast today. So as always, this podcast is brought to you by the flex diet certification, go to flex diet calm, and you can get on the waitlist for the next time that the flex died, cert will open. Right now it looks like that's going to be January of 2022. But in the meantime, that'll put you on the free newsletter, where you'll have all sorts of great content. So go to flex diet.com flxdt.com and hop on to the waitlist. So today as I mentioned, we're talking collagen with Shai, and she will be finishing up her PhD here very soon. Under Dr. Mike Ormsby. And we talk everything about her undergraduate work and her master's work with some of the Navy Seals and special forces, everything they're from potentially PTSD, some stuff related to brain impact, traumatic brain injury, I run pastor my crazy ideas about the use of ketones and other things that may be beneficial for TBI. And then we get into collagen. Is it useful? What is it useful for? What are some of the mechanisms of how it may help dosing, timing and a whole bunch of other stuff? So I think you'll really enjoy this one. And check it out. And welcome back to the flex diet podcast. I have a very special guest here today. Shai Liu, they pronounce her name wrong.

Fuller, shallow.

So Lou, okay. And we're talking about collagen. Then I met you after your great presentation at the International Society of sports nutrition back a while ago now. Yeah. So welcome to the program. We appreciate you taking the time to be here. Thanks, Mike.

Thanks for having me.

Yeah, no problem. You want to give us just a short little background of your experience and kind of where you're at and what you're researching. I know you're working under Dr. Mike Ormsby. Correct.

I am yeah, you're at Florida State University at the Institute of sports science and medicine. I originally came from San Diego, where I did my undergraduate and dual Master's in exercise physiology and sports nutrition at San Diego State University. And I also completed a dietetics program there. And then I went on to work for the United States Navy as a contractor or a research physiologist for several years. And then when I was ready to get back into my doctoral work, I came over here under Mike Ormsby, and I've been researching collagen supplementation for the last three years and we just concluded a large scale supplements study in older active adults. And that's when I met you at the ISSN conference back in June, when I was giving a talk on some of our findings.

Awesome. And are you at liberty to say what you worked on with the US Navy or is that still classified? Oh,

no, absolutely. Yeah, nothing classified. So I worked with the Navy EOD community. They're the ones that take care of explosives. Explosive Ordnance Disposal. And so we did a kind of like a human performance. surveillance program with them. That was intended to be a multistage program to develop a kind of surveillance from the beginning of their careers to the end to make sure that they're seeing good health physically, mentally, and, you know, operator readiness. And so I worked with them for a few years developing that program and assessing them. And then I went on to work with the Navy SEALs to look at how shoulder mountain rocket launchers were affecting some brain function. And that's kind of where I left off when I came out here to Florida State.

Awesome. I would imagine, and I've never obviously done this job or anything close to it, but being someone who would be potentially dismantling bombs, and then retiring from that, I just think that that would be one of the hardest transitions. Yeah, would anything I mean, because the, the stress and just everything that goes into that, and then to be done, I don't know, it just seems to me like, nothing will ever sort of, I don't want to use the word live up to it, but the highs and lows you would have from that job, and now not having that sort of variability in your life would be a weird transition.

I absolutely agree. And I didn't really need too many retired EOD, I have known a number of service members who have retired and at different stages in their careers, and they've definitely had a hard time transitioning. And I think that they do have programs for them. I think, you know, when they're in that line of work, some see a little bit more

that they do have programs for them. I think, you know, when they're in that line of work, some see a little bit more action than others, and some are more resilient than others, and some kind of keep thriving on that, that stress, and the adrenaline and some kind of, you know, want to spend more time with their families and kind of not be in danger at some points in their lives. So it is a little bit more individual. But it's definitely, I think, difficult for a lot of servicemembers to transition back to civilian life. You know, when they're ready to do that, or not ready, and they have to do it. So,

right. And you were just looking at more overall kind of welfare of them to make sure everything was from a physiology standpoint going well.

Um, so for us, we're developed, we're in the beginning stages of developing somebody something for their community kind of a surveillance. So what we were doing was, we worked with a number of different labs together. And we have developed kind of like, you know, a total body work that, in a sense, they would see the physiologist, which is me and some other people, we would do stress tests, we would do max, you know, one, one repetition, Max testing with them to see where their strength was, what their cardiovascular fitness was, we do nutritional assessments with them. We take salivary biomarkers of hormone responses, and look at their diurnal variation, and cortisol and testosterone and DHEA, then they would see some of the sports psychologists and they would take them through a number of different assessments for performance. And they would, you know, take a lot of survey evaluations for combat exposure and PTSD and anxiety, depression, a lot of those types of metrics, then they would go through functional movement screens, with biomechanics. And so all of that together, we would do a workup and we kind of start designed it so we could start seeing them annually. And then we also develop a report for them after each session, so that we could give them their their evaluations and then also recommendations on how what to do to work on certain factors that needed some work. And, and then after I left that lab, they were still speaking with the community about then developing educational programs to bring into that community where they could help kind of improve fitness in all of those different areas for them, so that it wasn't so much on them individually to do that. So, you know, the Navy Seals have always kind of had a lot of funding for those types of programs in place. So we are trying to develop something very similar to that.

Nice, let me very interesting, and it's nice that they have programs like that so that we can, you know, see where everyone's at, and then you can obviously allows you to do some type of intervention, as you mentioned earlier, instead of catching everything at the end.

Yeah, and it's a good way, you know, potentially as we talked about sports and a lot of investigators out there looking at different biomarkers and metrics to look at overtraining, for instance, and athletes. You know, just kind of developing similar similar kind of ways to monitor some of the warfighters also is good before you start sending them back out to combat or on deployments to make sure that they're ready. So it's kind of it's pretty important to think of it in that standpoint, too, because they are their athletes as well, the tactical athletes, so you got to make sure that, you know, you work them up and you you, you get them ready for performance, just like you would for an athlete going into a season.

Yeah, definitely. And do you think there is some risk of like shoulder fired projectiles and issues on your brain in terms of, you know, all the way from just mild concussive stuff to you know, full blown like TBI or traumatic brain injury?

So, yeah, I think, you know, there is a lot of that in that setting. So EOD, we did assess how many people were getting exposure and how many exposures. When I was working with the Navy SEALs, I actually worked with devic, which they deal a lot with the TBI is there and concussions. And so we collaborated with them with a blast exposure study, which was with the seals, not the EOD guys. And they were actually, you know, I did, I volunteered there and I talked to a lot of people and they have a full blown program and concussion and you know, different severities of TBI are a major issue in that community. All over military wide, obviously, some of them are, you know, from being deployed, and some of them are just that they're active duty, and they get into car accidents, or some other accidents happen. This the other study I was working on was actually with some of the shoulder mountain mounted rocket launchers and so those emit negative pressure waves when can actually impact the brain, similar to CTE, but it's called astroglial sparring. And so that's what we're investigating in that study to see how is that impacting these people, especially the range safety officers who are out there teaching the team guys that roll through every month, how to use these. So they're the ones that are getting a lot of exposure. So we are looking at, you know, the differences between those guys who are there in that post for three years versus the team guys who come through and only do this training, you know, as they're doing our workup, or even we started doing the SQ T guys as well. We're just basically the guys who just graduated from buds who haven't seen any action yet. So but I have not seen any of those results. So I can't speak to what we found.

Sure. Looking at nutrition interventions, do you think use of a ketone Ester or I know just having everyone do a ketogenic diet presents a whole host of other issues, but something like a ketone Ester as a supplement beforehand? Do you think there would be any beneficial aspects to that?

It's an interesting concept. I'm not sure if they're looking at that or not. Yeah, I would be interested to see if it has protective effects. I know that, you know, a lot of the creatine studies have seen that it can have protective effects against concussions. So I haven't seen anything like that in the literature with the ketone esters, though, have you?

Kind of like I did a whole like shameless plug, but I did a whole program for the Carrick Institute. They do. I'm associate professor there. So they do clinical neurology. So they, you know, a lot of the clinicians there deal with, like TBI, my buddy, Dr. Jeremy schmo here in Minnesota, and the Centers for plasticity are probably, in my biased opinion, like some of the top centers for recovery from TBI. And so I did a program for them on use of a ketogenic diet as an adjunct for potentially post recovery. But it's interesting, I think that there is some potential benefit for it because as you know, and for the listeners, like the two main things, if you just take a big whack to the head, is you get your energy, your body, your brain's ability to use glucose kind of goes offline. And then you start having a lot of

inflammation, you could potentially have your blood brain barrier can open up and now you've got your brain being flooded with everything else in addition to having a massive energy crisis at the same time. So there's some interesting studies with ketones that ketones can still supply the brain as an alternate energy source when glucose metabolism is kind of offline. And they might be having anti inflammatory effects via H DAC and some other other effects. In terms of like human subjects studies, it's really limited though. There was a couple studies that came out that showed it might be promising. But again, it's one of those things where everyone's like, well, we want the perfect randomized controlled trial. And as you know that it's never gonna happen in that area, right? You can prophylactically maybe treat certain groups who are going to be exposed to high forces, and not treat another group, potentially. But you're not going to set up a randomized controlled trial, where they come on into the lab will give you flak on the head, half of you get ketones, half of you don't, right, it's just, it's not going to happen. But I think there's a fair amount of preliminary data. And for me personally, like if I'm kiteboarding, and something horrible happens, I get dropped 15 feet out of the sky on my head, I actually carry ketone esters in my bags. I figured, well, I'll give it a go. Because I don't think there's much of a negative downside to it. And maybe there's an upside, but I'm not too worried about the downside. So I kind of hedge my bets in in that direction for a while. So

I that's a that's a good way of looking at it. And definitely very smart to do I kind of have, you know, similar thoughts about that to some of the sports that I do. If it's not going to do any harm, all it can do is maybe do some benefit. Yeah, that's very interesting. I haven't, I'd be interested to look into that a little bit more I was, I was kind of interested for a while with looking at some BDNF promoters that aside from exercise in that population, because I did, I did help those guys a little bit with some of the rehab in the gym. And I looked at kind of high intensity interval training on bikes for people that are actually able to exercise. And I think that there, I looked into Metformin, also potentially having some benefits in that arena, but I really don't know if anybody's looked at Metformin, and BDNF, but there are some other associated pathways that I thought that might kind of cross and so I thought it might be a mimetic for exercise, potentially in populations that are injured, to injure, to exercise to increase BDNF for to help promote some recovery, but um, you know, so it's, it's kind of some, I, that whole area of research is really intriguing to me.

Yeah, and there's, you know, it's mostly animal work, but I think there's some human work now showing hippocampal volume increases with moderate aerobic exercise. And I think there was a study done that showed the muscle is actually releasing BDNF. Does that sound correct?

Yeah, so I think there's two mechanisms. There's muscular release, and then we have the release in the brain, right? There's irisin involved in the muscular. We did, we did have an abstract at ACSM. For 2020, as a virtual one on, we went back and looked at some of the blood from ultra man to look at long duration, high intensity exercise and BDNF because it's really unexplored. I mean, nobody's ever looked at exercise more than 60 minutes. And it does, it's, it's mainly released at, you know, above 80% of your two maps. So it's kind of like, you know, you'd really have to do like some hit work to really get those increases, and nobody really knows how long they they remain elevated, because, you know, they kind of dropped back down to baseline values pretty soon after exercise, but again, it's it's really just been under studying in my opinion. So but we did see some elevations with that three day ultra endurance race, which is really exciting. I think, when we can eventually go back to that race, I think we'll probably look at it a little bit more in depth, too. So

that's why you think supplements like Lion's Mane actually increase BDNF?

I haven't seen any studies with BDNF. I have seen that, you know, I've seen you know, increased cognitive function potentially. I've definitely tried it. I can't. I think it works. I'm not sure it could be a placebo effect. You know, me and my n of one. Yeah. So but yeah, I love the I love that whole area of research with cognitive function. And collagen actually is also being looked at in that realm too. So

super interesting. Yeah. Anyone I took a shitload of lion's mane. Before I did. With my buddy Jeremy schmo. I did a week of intensive basically neuro therapy at his clinic so I would go in did an assessment and then I would I just stayed in a hotel room. And outside of the cities and did three sessions a day for a week and I took a couple grams of Lion's Mane per day. I'm like, it's pretty safe. I don't really know. I mean, the end result is it seemed to work, but who knows? You know?

That's good. Yeah. Yeah, with a lot of those, you know, just I always question especially if, you know, obviously, you know, if you're on any other medications, what, that's the only thing is I think about all the vitamins that I take already, and I have no idea how they're gonna interact with each other. So

yeah, and psilocybin can increase neuroplasticity to but that's currently not legal. So yeah, tricky.

Yeah. I've been seeing a lot of headlines on a lot of the psychedelics being utilized for treatment of many different things, including PTSD. Yeah, MDMA? Yeah. Yeah, so I haven't had a chance to really dive into that literature yet. But I definitely have that, you know, on the to do list for when my schedule opens up a little bit more.

It's pretty interesting. I mean, I've read not all of it, but a fair amount of it. And it's, I mean, especially in the area of mental health, it's very promising. I mean, obviously, it's still pretty early. But some of the studies that, you know, maps, have done Rick Doblin and those guys are pretty positive, you know, and they're very nice, you know, well designed studies, you know, rolling girlfriends has helped with that a bunch of other people. So it's, it's cool to see, you know, potential solutions now, that are being tested in a very rigorous scientific manner. And so far, you know, the results are pretty darn promising. So hopefully, that'll trend will continue.

Yeah, I hope so. And it seems that they've had really positive results in areas where other things have not really been very effective. So, yeah, I've seen a lot of advertisements also for some of these combination therapies to some of the psychedelics like low doses and cognitive behavioral therapy, and

yeah, and that's what's interesting, too, is that the model they're using is combining, you know, some type of talk therapy, you know, with it at the same same time. And, you know, the reported change in, you know, one to two sessions is pretty, pretty crazy. But again, as they point out, it's, it's probably the combination of it because not everyone who just takes the drugs by themselves has these massive changes, it's most likely the combination with therapists, you know, being guided under, you know, controlled settings to

Yes, absolutely. I know that I think the military, were the ones that kind of started with the research into sensory deprivation. Yes. So you know, a lot of stuff stems from military and gets kind of is brought out into the mainstream. And so now, I haven't seen it too much. You're on the east coast, but on the West Coast, it's a huge booming business for the float tanks and a float sanctuaries. And I've actually tried him and they are incredible. So personally, I can attest to, you know, body wise feeling relief of physical tension, and then also just really does help like with we're so overstimulated all the time. So yeah, there's a lot of really nice new alternative types of therapies that are coming out that seemed to be pretty effective.

Yeah, I'm a big fan of flow chambers. i The first one I did was actually here in Minnesota, like, six years ago now, I think. And it was in the bottom of this small practitioners place, it was one of the early designs where it looked like you were crawling through a dryer in the wall. It was not, not real big. And I get in there. And it took me probably almost six months before I did it. So I'm like, do I really want to be not without any stimulation and left alone with my own brain for like, 90 minutes? Like this sounds like a horrible idea. Probably do it then I guess. And I remember laying there and my first thought was, Wow, I didn't realize I had this much tension in my neck and my low back, right, because you're removing a lot of other normal sensations you have, right and then my next thought was after about 30 minutes, I was like, Oh, this is the last deployment of the day. Are they gonna leave me down here? What if they forget about me? Could I get locked in all these other thoughts go through your head.

Yeah, it's interesting what what happens when you're left alone with your thoughts? But I think a lot of the hallucinogenic types of therapies also kind of try to promote that to is like digging deep and go Within without all the external noise, so

yeah, yeah, I did a combo and I was in Costa Rica this last January. And the place that we went the shaman down there, I talked to her for a month before and after. And she was saying that the treat a lot of, you know, military

veterans for everything from PTSD to all sorts of stuff. And it was a pretty crazy experience. And if anyone looks down that path, I would spend a lot of time making sure you know what you're doing, making sure you're going to a place that has done it a lot. I mean, my experience was was great. I did a whole podcast on it. But after having that experience, I could definitely see how stuff could go bad. Really, really fast.

Yeah, so I actually have a big Tim Ferriss fan, and oh, yeah, yeah. So, you know, he does the, the tools for Titans. And, um, a lot of people actually a lot of, you know, the, you know, leading pioneers of industry, do this trip with the shamans that now I've heard about, you know, they have these trips, and they did mention that, you know, it can be very eye opening, but really, you have to make sure that the person is absolutely knows what they're doing. And very reputable because I can only imagine how it could go wrong.

Yeah, yeah, it's, it's one of those things where I explain it to people of it, I think in the right hands and done while the compounds themselves don't really present a lot of you know, toxicity or risk, but the environment and how you're being watched and everything that's going on. One of the things I remember, during part of the ceremony was just lying there. And we went out with a group of people that we knew all of them, except for two is only eight people small thing. I'm realizing they're going, Wow, this is so cool that all these people wanted to do this experience. And I'm just here with them. And they're not a bunch of dickheads. Because I remember just thinking that, wow, if there's a bunch of people that, you know, maybe weren't into it, or didn't know what they signed up for, or, you know, other things, I think the experience itself would have been quite different. So it was

Yeah. Yeah, absolutely. Actually, that would actually freak me out. If I found out that I was going, I was going to do that experience with a lot of people I didn't know, I think that would be a little bit more concerning for me, or anxiety provoking, but I guess the right, the right combination could definitely make it a good experience. Yeah, I find it intriguing. I haven't tried anything like that yet. But we'll see what what comes in the future. So

yeah, I mean, the flip argument to that too, is that if you're off kind of in your, your own experience, you probably don't even know where you're at. So I remember the guy next to me. The shaman came around. And I think he had like one or two doses. He's just lying there on the side, like super quiet, like a lot of other people were are throwing up crying, having just, you know, crazy stuff going on. Oh, wow. So the shaman comes over to him. And she's she's like, how are you doing? And he's just like, Ma? And she's like, Do you want another dose? And he goes, No. And I'm like, he was just lying there. So quiet. I'm like, yes, he's going through some shit.

Yeah, he's deep in there. Yeah. I can only imagine. Yeah, I think it took a lot of courage, I think to to go down that road. Because that that's pretty scary. intimidating.

The definitely can be I mean, some people listen to the episode, they got the two responses of that was kind of interesting. I think I'll check into it more. And the other half of my friends are like, hell no, I'm never doing that. That sounded like it was incredibly crazy. And I'm definitely not doing it now. Like, that's cool. You know, whatever. Whatever you decide, I just want people to be somewhat informed before they do anything. So

yeah, absolutely. I was I was so surprised when I heard that in the in the Ferriss podcast that it's kind of like a regular thing for a lot of these people. But yeah, they definitely do a lot of research before they decide who to go do that with. And so I was that the common theme between people.

So yeah. Cool and transitioning to collagen, like, just give us a little background on collagen because for the longest time, like when I was doing a lot of my undergrad stuff, it was like, Oh, this worthless protein, it doesn't do anything and it's just not doesn't have all the good essential amino acids and it's, it's just a crappy protein. You don't worry about it. And now it's kind of gone the other extreme because everything in fitness goes from one extreme to the next. Right? Collagen will do everything thing for you?

Well, it's funny because so you know, and I've spoken to some people and they, they don't even want to, they kind of said that, like maybe collagen would be looked at a little bit differently if we didn't call it a protein. But um, I actually, I teach Introduction to nutrition, and I lectured on protein today. So it's absolutely a protein, it's actually the most abundant protein in the human body. If you look at it, from that standpoint, approximately 30% of our total body's protein is collagen. So we have it in all of our tissue, we have it in our skin, or our bone, and our teeth, those are made of collagen matrix that just filled in with, you know, some of the calcium and phosphate and some of the minerals, and all of our, you know, tendons or ligaments, our vessels, everything has collagen in it. So, you know, it's a large component of the extracellular matrix with elastin, and I think it gained popularity a long time ago with with skin rejuvenation, and anti aging, and they did see a lot of benefits that were backed by research. And so people have been taking collagen for a long time for skin. And I think just recently, it gained some popularity as something for joints, I think, you know, going through undergrad, and even grad school, everybody was talked about glucosamine and chondroitin. And then the consensus was basically that, you know, they're not really that effective. And it's funny, because I've been at Florida State now studying collagen, pretty much from the day I walked in the door. And that was three years ago. And I probably started taking collagen about four years ago, I have a lot of like sports related injuries that are chronic, and I heard that it could potentially help me with some of my joint pain. And I felt like it actually did, and I've gone off of it multiple times to see if the pain returns. And it does. And then, um, you know, added benefits are that I get a lot of compliments on my skin and my hair, because

everybody likes that. Yeah, exactly.

So people are always commenting that they can't believe how old I am. So um, you know, just like all, I'll continue the use of this just for those benefits. But the fact of the matter is that, you know, I actually saw a lot of improvements in my own functionality. And so we did do the study, we gave people, collagen supplements in three different dosages, we had a placebo group, 10 grams a day, and 20 grams a day. And they actually split those doses in half. So they're asked to take their, their dose in the morning and in the afternoon or evening. And it was a double blind study the entire time. And we had participants a ticket for six months and nine months. And it was pretty much evenly split 5050 between males and females 40 to 65 years old and recreationally active majority of their lives with no diagnosis of any kind of osteoarthritis or any major injuries just kind of activity related chronic pain. And we did see that, you know the on some of their survey measures of activities of daily living, which would translate to physical function, that are 10 gram a day group actually saw improvements in activist daily living. And then when we looked at people who are exercising more than the recommendation for weekly activity for healthy Americans that we also saw reductions in pain in the same scales. So in that sense, we did see proof of concept on those measures in that study that we did. We're still analyzing and actually digging way deeper and further with some of the mechanistic stuff with the blood that we have to look at maybe what are the reasons that we're seeing those changes? So are we you know, are we seeing increases in collagen production and repair? Or, you know, what are some of the potential mechanisms that, you know, allowed us to see some of these improvements in physical function? So that's kind of the gist of it with collagen from, you know, my research standpoint, you know, people are looking at it for a number of different reasons. They're looking at it for body composition improvements, they're looking at it for pain for increased function for osteoarthritis, there's been a ton of studies on that. And I think they're starting to look at it with look at how it could potentially improve cognitive function for a number of different reasons, and obviously vasculature can also be improved, potentially, just because if we're, you know, improving or enhancing synthesis, then we might be able to repair some of the endothelial cells. To have collagen, um, so multiple, multiple mechanisms of action, especially when collagen is so abundant in the human body.

Very cool. And in the study, was there a difference between the 10 gram and the 20 gram dosing per day.

So with the, with what we saw significant changes in for the 10 gram a day group, we saw like slight improvements in a 20 gram a day group, but they weren't statistically significant. So, I think there might be a potential that, you know, if we're introducing a certain amount of these bioactive peptides, which are thought to be kind of the reason that we're promoting increased synthesis, that, you know, maybe there's kind of like a blunting effect with too much in the pool, potentially, if we kind of think about it as like an amino acid pool. But you know, it's the glycine and proline and hydroxyproline, which are the main three amino acid constituents of the collagen. And so when you're when they're found in these di and tri peptide, combinations, which have been shown to be actually absorbed through the digestive system into the blood intact, they're known to have bioactive effects when they're intact like that. And so. So it could be possible that the 20 gram, a day group just has too much of it, and it's just dampening signal. But yeah, so the 10 gram a day group seems to be effective in our study, there are studies out there that have seen improvements with 15 grams a day, but we did test the difference between 10 and 15, and 15, and 20. So it would be interesting to see if 15 is optimal dose.

Yeah, because you said it was split. So they're taking five grams in the morning and five grams in the evening, which, at face value, and I know, I'm always biased, because I think of sort of a raw materials standpoint, not a cell signaling

standpoint. It just seems like such a tiny amount. But I think to your point that maybe they're providing a raw material for certain things in the body, but maybe they're triggering all these other processes that they're up regulating. And maybe that's some of the benefit, too, is that correct?

Yeah, definitely. So there's, I mean, there, there are a lot of reasons why we might be seeing these, these kinds of changes happening. Also, speaking of raw materials, you know, glycine is one of the main amino acids. And although it's not an essential amino acid, a lot of people do argue that it could be considered essential or conditionally essential just because we use glycine for almost every single process in the human body. And so if you really think about it, we're probably not consuming adequate amounts, and producing adequate amounts to really facilitate all of that. So the fact that we're providing a good source of glycine by consuming, the collagen is just from a raw material standpoint, just work, we're giving the body what it needs to be able to continue and do these processes that it needs to do, which is usually lacking, especially in our kind of Western diet, where we don't have high glycine containing foods.

I know that was kind of the glycine hypothesis, which I know has been kind of gone back and forth. And I've even gone back and forth on it. Like at one point, I was like, I don't know, if you just eat enough protein, you're fine. And then I'm like, wow, I don't know, it doesn't really show up as much as I thought there. So now I'm like, I don't know.

That's the crazy thing that there have been a lot of studies that have looked at lysine and the blood after with, you know, people that are consuming kind of like a high protein diet. And they looked up comparisons between meat eaters and vegetarians, and they actually found that vegetarians had higher glycine levels in their bodies. Yeah. And then that was also on the high meat, you know, was those diets were associated with metabolic disease and, you know, with with weight loss, like glycine constant actually went up. So, there's a lot of interesting stuff out there that you just kind of have to tie it all together. I've been swimming in this literature for a while, so I kind of have to, I'm kind of doing that right now currently. Um, but yeah, so there's that element with a glycine and also glycine is known to be anti inflammatories. So that could also impact pain just by itself. And so, you know, I have been asked to people just take lysine, will that be effective, but the thing is that, you know, we're also seeing the benefits from the combinations of glycine with proline or hydroxyproline. But we're also seeing a lot of benefits from the proline and hydroxyproline. Also, there have been some radioactive labeling studies that look at, you know, where are these amino acids going when you're consuming it? And so they are finding that you know, higher amounts are going into Do cartilage for instance. And so areas that might need a little bit more repair than other areas. So it's a it's a mystery. It definitely is. But it seems that we are seeing some very positive results in the literature and in our study, also. So I find that it's a very exciting time to be in the collagen in the collagen arena.

Yeah. And what's it there's something with glycine that was supposed to help promote sleep? I'm blanking on more I read that or I could have completely made that up. And someone on the internet told me.

No, I don't think I came across that collagen in sleep. So I think that, you know, maybe if I put that into a search, I might, something might come up. I mean, when I looked at glycine, the dish that so many mechanisms that glycine is involved in, it's virtually involved in every single physiological process in the body, which is why you know, there is that hypothesis that right, yeah, that, you know, we do not have enough, and we definitely cannot make enough in our bodies. But I found that very interesting that the vegetarians actually had higher glycine contents, and that was, the low glycine was also associated with metabolic disease. So

in your study, was it a particular type of collagen or

so people look for? It's type one type three combo, it's made by a company out of Belgium that did obviously fun to study, but it was double blinded, so you know, kind of controlled as much as possible, and we did have a placebo. And, and so it's very similar to, you know, a majority of the type one type three combo, collagen products that are out there, generally, the type two collagen products are in capsule form. And, you know, there's still, you know, a lot of questions whether or not the type of collagen you're consuming actually has any kind of impact on which tissues, it's directed.

Yeah, that was my next question. Yeah.

So that's something unfortunately, I haven't been able to answer but they have looked at, at where the collagen goes. And it does look like when you're doing when you're consuming a collagen one, three, that you are also seeing the distribution of those amino acids to connective tissue that would be predominantly a type two, such as the cartilage. I have not seen any studies that where they consumed just type two cartilage and looked at whether or not that was being distributed to the skin and other tissues, that would be mainly type one collagen fibers and type one and three are predominately found in your skin and your ligaments and your tendons. And, you know, type two is generally found in your cartilage. So there's that kind of distinction. And, but I don't think anybody can really answer the question, but it does look like the type one and three does also positively impact cartilage. So I don't know that converse is true.

And correct me if I'm wrong, but type one and three are primarily in like animal hides and sort of cow bovine sources. Is that correct?

Yes. So you can, the most popular sources are going to be bovine and porcine. So from cowhide and pig. And then a

Yes. So you can, the most popular sources are going to be bovine and porcine. So from cowhide and pig. And then a lot of some of the fish also that's becoming pretty popular. I've seen that. Yeah, the fish skins and a lot of you know, their collagen containing tissues. And then I chicken sternum is kind of what they're using a lot for the type two collagen. Yeah, yeah.

Is there any data you would say to mix up the kind of collagens you're taking so far? Or should you just kind of just pick one and try it out? There isn't really a lot of consensus yet on the different types.

I haven't I haven't seen anything where they've really mixed a type two, I do think that that's kind of the next step where people need to start looking at that. And then also looking at dosing timing, it does seem that there are some strategies that you know, people agree on that it should be taken like approximately an hour before activities, so you can get greater blood flow to those areas that are poorly vascularized, like the tenants. But, you know, that's also kind of lacking, too. So I think the two areas of research that really needs to be investigated a little bit more would be, you know, which tissues do the specific collagen fiber types that you're eating? Are they directed to specific tissue and would a combination be better and then also, you know, when is the best time to take it, you know, should especially surrounding exercise since exercise seems to induce the greatest benefits with collagen consumption. So I'm not sure if the The literature really support seeing it in really sedentary populations as much as it does with in conjunction with like an exercise program or in an active population.

Yeah, I mean, that's, I mean, we talked about this, I said, that's one thing I did. And maybe three and a half ish years ago, I started doing the 15 grams of collagen 40 to 60 minutes before exercise. It seemed to help. And then I started doing it with clients, and it seemed to help them. It was based on a lot of work from Dr. Keith bars lab. Yeah. And what are your thoughts on that? Do you think like, I always think of potential upside and downside again, of I don't know, I mean, we're probably again, probably never going to have the perfect study, because no human is going to be like, oh, please take part of my ACL and destroy it and see if it's stronger than what it was before, you know, so we're probably always gonna be someone, I think, limited with some of those studies. But some of the stuff he's done with, you know, some ex vivo models and limited still

engineers. Really cool stuff. Yeah. Yeah, no, I definitely, you know, it makes complete sense to me to take it beforehand, because that is, I mean, a lot of the target tissue is really poorly vascularized. And, and so you know, the only time that you're really getting increased blood flow to those areas is during activity. And so it would make sense that you want to have ample amounts of those bioactive peptides in the blood circulating so that, you know, they get delivered to that tissue in higher quantities, so that we can potentially promote increased synthesis of new collagen fibers. You know, there's something interesting that I'm going to start looking at right now is, for the last component of my dissertation is the matrix metallic, pretty nice activity, which are the enzymes that actually degrade those collagen fibers. And depending on which, which types are kind of up and down regulated, it could be an indicator of either clearance of broken down unhealthy fibers to make way for the, you know, the synthesis of new fibers. Or it could be just degradation of intact fibers to so I'm really curious to see what that turnover looks like with the supplementation, whether that promotes actually like more of the clearance, because they do kind of get

tangled up, like, you can think of it as a, like a bamboo jungle where some of the bamboo pieces are kind of broken. But because they're so tightly packed, it doesn't ever get cleared away, and then you never actually grow like a new bamboo there. Because there's still one that exists there. But it's not helping kind of hold up the structure, right. So you can kind of think of it as, that's what the matrix looks like. And that's kind of essentially how like scar tissue kind of builds up. Yeah, and once we have that, you know, the integrity of the tissue is never as strong. Whereas if you're able to potentially clear out some of the kind of the old and damaged fibers, then you might be able to regenerate or synthesize new fibers there. And hopefully, that would lead to increase function and decrease pain. And so, you know, that's also an interesting thing to think about. So that could be also something that's happening with timing, because those are also they're kind of force mediated as well. So it's not just the increased blood flow, but there are other, you know, enzymes that are activated in the presence of some of these forces. So so it does make sense to kind of have that collagen present there for when we're kind of priming that optimal environment for enhanced synthesis, I think.

Yeah. And I believe this has been pretty much dispelled at this time. But I'm probably guilty of saying this. I know in the past that if you look at your muscle tissue, it takes around 90 days to kind of completely sort of turn over but soft tissue, collagen, connective tissue, etc, as more like nine months. Yeah. But I think there's some newer data, isn't it from Luc Van loons lab and some other places showing that that's probably not true. I don't know. What are your thoughts on that?

I'll have to catch up on that because I haven't seen any of that literature out. But when I look at the literature for some of the biomarkers for collagen and bone turnover, really slow. Yeah, really slow. And so it's hard to actually pinpoint whether or not for instance, if you're looking at CT x and p one and P whether or not you're looking at if you're looking at bone or collagen because there's nothing that differentiates them. But you can kind of think of it as like time course wise. They both have kind of long half lives. And so, yeah, so I don't know, if they're finding that it's not nine months. But I mean, it's definitely longer I think, than muscle tissue, which is why it takes a longer study, and which is why we extended our study to nine months, just because it seems that you can't really see things happening at that level turnover level, tissue wise, if you're not looking at it for extended periods of time. Same thing with, there's only one study that's looked at long term, collagen supplementation with bone mineral density, and there's a study out there that looked at one year of five grams a day, and they actually saw increases in bone mineral density, and in postmenopausal osteo, pyrosis osteopenia, females. But, you know, nobody's been able to see any changes in bone mineral density, in less time than that. And that makes sense, because the literature says that you really wouldn't see changes in bone mineral density before then. So I think the connective tissues also kind of on a similar time scale might be a little bit shorter. But I'm hoping to get at that with some of the other markers that we're going to look at with the matrix metalloproteinases and TGF beta.

Yeah, cuz I've often wondered then if you know, strength training or trying to add muscle or take your pick that is the process going to be limited, then by the thing that turns over the slowest. Right? So if muscle is turning over faster than soft tissue, are you limited by how fast and how strong, you can reassemble the soft tissue, right? But the premise being that your body's very survival oriented, and it's going to try to shut down some level of performance before you injure yourself? granted us silly humans can easily kind of override that at certain times. And then I started thinking, is it going to be limited and maybe by by bone, right, because the people think of bone as being

very, ultra stiff, but it does have some, I guess, like a better word elastic properties to it without getting into the mechanics of material of it. So are maybe some of those things that like collagen, maybe it's beneficial to increase the turnover of those rate limiting structures?

That's a fantastic question. And something that I think is drastically overlooked. I think that, you know, when we're talking about protein, we're always talking about muscles or

muscle, just

the thing that's overlooked is that, you know, what connects the muscles to the bones? And you know, the bones to the bones? Is that connective tissue, and then you have the bones themselves, too. And, you know, a lot of the injuries are actually in that connective tissue and most quarters. Yeah. And so, you know, and I think that, I think that, you know, kind of like a training program with like, a supplementation program, like, for instance, people take away, I don't think that collagen should be something that should be used as a substitute, but as like something that should be co ingested, potentially, to help with targeting benefits to the different types of tissues to support each other, right? Because, you know, if we're trying to build muscle, and we're trying to produce more force, and all these things, if we're only focusing on the contractile fibers, and, you know, increasing the lean muscles size, then, you know, we're kind of neglecting to look at what are all the supporting tissues around the entire body that are going to facilitate those movements, and, you know, all that force production. So, yeah, I think it's interesting that, you know, we've kind of neglected to really look at the other tissues, aside from bone, I mean, aside from muscle, skeletal muscle, and I think that it's something that we need to kind of look at. So I know they've done some proteomic studies with collagen supplementation, and they have seen that some of the supporting structures are really the protein synthesis is upregulated with collagen consumption. And so I think that they need, there needs to be a differentiation, when we're looking at these kind of these benefits with these gains, in we need to separate out the tissue that we're specifically targeting. And I think we need to look at it as like a whole system, kind of, you know, working together rather than just always kind of targeting like the skeletal muscle itself. So

yeah, I mean, that's what I've had clients do for many years now, especially if they're really kind of pushing the envelope is, if they're trained in the morning, you know, one scoop of whey and 15 grams of collagen like an hour before. If whey bothers their stomach, they'll drop to, you know, six to 12 grams of just essential amino acid and a collagen, man. It's all anecdotal. So you can't really compare it. But that seems like it's been beneficial. And then if they have some type of acute injury that they're cleared from their physical therapist, they can start very light training. I'll have them do one session in the morning, take that an hour before. And then before the other session in the afternoon did the same thing again, because I think the missus from Keith bars lab, but doesn't the how long the sort of synthetic response stays active is what was it like six to eight hours or something? So in theory, you could maybe do it twice per day to try to get more benefit of remodeling.

Yeah, I mean, I think that there have been a couple of studies out there with some of the tendinopathy research that have done by daily rehabilitative exercise. And they're not like huge. They're not like a full blown workout. They're just No, like, go through your exercises twice a day. Yeah. And then they did instruct them to take the collagen beforehand. And they did see massive benefits, in return to play, decrease time to play. All of those things. One thing I want to mention, though, and that, you know, I think we don't want to neglect this, that we want to make sure that we have some kind of fresh source of vitamin C, when we do I was gonna ask about that. Yeah, yeah. Because you know, especially if we been fasted all night, and then we just have some way and stuff like that, we might not have enough to really promote that hydroxylation of the proline, and hydroxyproline is one of the, you know, 1/3 of the major constituents of that collagen. And I think it was SHA, one of the studies, they looked at me with a vitamin C, they, they found out that, you know, after an overnight fast if they didn't have vitamin C with the collagen, that they weren't seeing the same effect. So really interesting, because we kind of take for granted that we think that we just have ample amounts of vitamin C just you know, circulating throughout and that we wouldn't have to consume it with it, but it looks like a supplement that would have vitamin C, and some way and some collagen would probably kind of be one of those optimal types of like, you know, pre workout, especially for rehabilitative stuff, kind of products out there. But I haven't seen anything like it yet. So

I don't understand that because I promoted those to a couple of supplement companies three years ago. And I'm like, this is a no brainer, like, look at this search, collagen, vitamin C, you know, add a few other things for your pre workout, some essential amino acids, like, you're good to go, like, you can add stems, not add stems, you know, right, whatever, like creatine, caffeine, whatever. And right, and this, this would appeal to probably the biggest population, you know, older people that are looking to get back in the gym, or, you know, athletes that are training really hard, like the story is pretty easy to sell. We have some preliminary data on it. I mean, you know, better than I do that have supplements, I have no data on it anyway. So no, right, right.

I mean, I'm so grateful for the companies that are actually out there getting the research vendor, they're investing in their products, and there's a lot of money for this research. And, you know, and, you know, hopefully, people recognize that and we'll kind of stick to the companies that are, you know, making that investment. But yeah, you're absolutely right. I 100% agree that I do not know, it's a no brainer to me. Also, I don't know why it doesn't exist. Yeah.

Yeah. So my, my poor man's cheap version, if clients are really on a budget is just buy the bulk essential amino acids. I don't smell them because they smell like cat piss. They're horrible tasting, they form like crazy. And then buy powdered a lime juice in a powdered form. And then add that with your 15 grams of collagen. So that's my poor man's version.

Very nice. Yeah, I've never tried the powdered lime powder, but I know that just like powdered Vitamin C is dirt cheap.

Yeah. Yeah, the downside is that you don't need a lot. And if you put too much in, you're gonna be in the bathroom not doing your training. So wash them out.

Oh, yeah, that's a good point. That's a very good point. Yeah, I mean, the great thing about you know, I don't know I haven't really played around with essential amino acids but the great thing about collagen versus way is that collagen dissolves in pretty much anything like oh, yeah, no way. Caffeine, coffee drinks with whey my entire you know, adult life and the nature's it's always a hassle cooking with it, you know, collagen you just throw it in some coffee. It's relatively tasteless and odorless and, you know, it doesn't clump or anything. So it's super easy to work with. So yeah, just kind of figuring out what you can put the actual, you know, essential amino acids in that won't have that effect. Then you have the perfect product.

Yeah, well, when you supplement people are Listening. I mean, my percentage. Yeah, like where to find you. So they need research on it. We have a researcher here. So, yeah. What, as a follow up to kind of a last question as we wrap up for someone listening for general health, let's say, Okay, I believe you, you're crazy people, and I'll take it before training, but for general health purposes, is there a recommended amount of collagen per day? And then the follow up is, can they get that from, you know, real food? And if so, did they need to start eating cow tails and noses and stuff are what do they do?

Oh, yeah, good questions. Um, I think the literature supports benefits, anywhere from five to 15 grams a day, as low as five, it just sometimes it might take a little bit longer for you to see some kind of differences depending on what your goal is, whether it to whether it's pain, skin, bone, you know, injury recovery. But I think as little as five, you know, in our study, we saw, you know, five grams twice a day was beneficial for, you know, activities, day living and pain. And so, I would definitely say that that would be the recommendation as of right now. And I think you can dip down as low as five a day. And then there is a difference between the hydrolyzed collagen, and actually eating it in its native collagen form. And they have looked at studies and seeing that, you know, it doesn't have the same effects, potentially, a lot of the effects that we're seeing from the hydrolyzed collagen is because of those bioactive peptides, so those di and tri peptides is the glycine, proline hydroxyproline. And so it's you're not necessarily going to have those intact peptides circulating in the bloodstream after eating an something like a bone broth or gelatin even. Just because it's not formulated that way, I mean, you'll definitely have those amino acids available. For you know, whatever processes you need, like we talked about, with glycine as being a protein present to potentially support a lot of its functions. But it seems that the hydrolyzed collagen has the added benefits of having those peptides already intact. And those actually, we have peptide transporters, and then we have individual amino acid transporters in the gut. And so we have preferential absorption of those intact peptides. So they potentially get into the bloodstream faster, even though nobody really knows how they get into the bloodstream intact, because there don't seem to be any transporters. So that's another kind of area of study right now, is that are they being you know, are they being kind of, you know, brought out of the intestine, like, in vesicles, or by some different modes of transport, but regardless, they are seeing that these intact peptides are prevalent into circulation after consumption of, of hydrolyzed, collagen up to two hours post basically peaking. And so that seems to be a big difference. And that could potentially be a big difference in some of the effects that you would see between eating something that is like a bone broth or a gelatin based food, versus having something that's been kind of formulated and broken down into those constituents. So long winded answer, I apologize.

No, it's good.

But yeah, so um, you know, it seems that the hydrolyzed protein, collagen proteins or peptides are a little bit more beneficial or superior to native collagen products, just for those reasons. But I think eating the native collagen is going to be better than not having a good source of it in your diet period. Because that is kind of what our, you know, our caveman ancestors were eating and so you know, I don't know if they were if they had increased, you know, healing or not, because we haven't been able to study them, obviously. But so that's another question there. So,

no, that's good. Because I'm, I'm all for eating real food. I think that's the the basis of your diet, but at the same point, sometimes with supplements and modern technology doesn't make it evil. I mean, right? Creatine, the amount of you know, steaks you need to eat to get five grams of creatine today. Yeah, good luck, you know.

Yep. Yeah, we're able to, you know, produce things in concentrated amounts that are, you know, therapeutic and so, um, you know, dose makes the poison or the medicine and so we're able to make medicines out of these foods that normally wouldn't have the benefits that they do in their native form. So I definitely think that we should take advantage of the ones that we have been able to, you know, use with science. It's just like everything else, all the other developments we're living longer. We're getting stronger. And it's all thanks to a lot of the research that we've been doing so

perfect. Well, thank you so much. What's next for you? Is Dr. Ramsey gonna let you out of there and anytime soon or?

Yeah, I'm actually in the job. I

just like, give him a bad time. So it's it's all my, you're doing great.

Great. He's been he's been wonderful. Yeah. And I don't know the world is my oyster. So I'm currently kind of, you know, exploring job opportunities, since I am about to head on out of here and, you know, be on my own again. So we'll see hopefully supplement research or maybe some aerospace physiology with the military or NASA or something along those lines. So or maybe I can kind of do a little bit of both. So we'll see. Yeah,

that'll be maybe a topic for another time because I took when I did my masters, there was a guy who started the exercise program at Michigan Tech, who taught a class on aerospace physiology. He was one of the physiologist from the US and worked with Russian cosmonauts for many years worked with NASA. And to me, it's just fascinating because it's like all the stuff we do for exercise and strength training. It's like the inverse like bizarro world. It's like the opposite. Know, you're in microgravity, everything's goes to shit.

Yeah, I had to explain to my nine year old daughter when I was telling her that I was looking at, you know, working with astronauts that I have to figure out how to not let them turn into mush, basically.

Yeah, and don't volunteer for one of those who didn't they do a 90 day bedrest study, I think, like to go,

yes. When they were looking at the fiber type changes. Yeah. Yeah. And there are so many people in my muscle physiology class, they were like, I would totally do that. And I was just like, for one day, not for any amount of money, would I ever be able to do that? So no, no.

I think one of the studies I don't know if was that study, they actually had a crane that lifted him to the bathroom. So it's not even like you're, you're getting up to go to the bathroom, you're, you're trying to stay laying down. It's just like, you know, increased downhill slant a little bit to on top of it, and you couldn't pay me enough that they didn't just

insert catheters into the all the orifices just to like, eliminate any need for movement. But I'm ready to the details of those studies enough to actually think about the bathroom.

So yeah, I'm pretty sure that a Foley catheter for the urine the other one might be a little trickier. But yeah,

definitely. Yeah. Interesting topic for another day. Absolutely.

Well, if you want to be found, Where would people find you or other potential employers and they want to hunt you down? Where would they go? That is a very good question. So we don't want to be found. So that's okay to

know, I do want to be found and you want to be found. I do have an Instagram account, you can find me under shilowa COVID kowski. I know it's a little bit difficult to spell. So um, or at the IsSm FSU website, or the now we just changed our department name from to the Department of Nutrition and integrative physiology at Florida State University. So my contact information is all up there. If you can't find me on social media.

Awesome. Well, thank you so much for all your time today. And sharing all of your knowledge was super interesting. And I'm always grateful to pick your brain, especially with all this stuff on collagen. And it's great to hear from someone who's spent over three years looking at it on a day by day basis to so it's thank you so much for sharing all that.

Yeah, absolutely. Thanks so much for letting me give you my spiel, nah. talk your ear off about colleges.

No, it's good. Because I think it's one of those areas that's just going to become more and more popular. And as you know, in fitness and something becomes more popular. There's just a whole bunch of crap. That's not even remotely true.

Yes, yeah, absolutely. And yeah, I mean, I'm still trying to kind of figure it out myself. But anecdotally, I didn't mention this previously, but we did. Once we unblinded the study we did the supplement company did send a year supply to any of the participants who are interested and so a lot of them were from track clubs and triathlon clubs around Tallahassee. And so I did give a talk virtually to them and to give them the findings and kind of given the PowerPoint about the background of you know, you know, collagen, so they knew what they were supplementing with And anecdotally, I had so many people give me so much positive feedback about how they, you know, they didn't see any changes. They were like, Oh, I must be in the placebo group. And then obviously, there's, you know, the, you know, potential for people SIBO effect here, but when they were sent the actual product, they were like, I saw so many improvements on my pain dissipated after about three to six months, you know, kind of consistent with all the

literature and they weren't really aware of the literature. So it's just, it's really funny because I personally, you know, I've gone off and on of, you know, trying it, and I realized that I do see a difference when I do take it for a little while again. And it was really nice to see that people felt really positive about, you know, their experience with it. Whereas a lot of things that you test, generally, you know, people are really skeptical, or people are just kind of, you know, mixed on their feelings of it. But especially the fact that people in the placebo group got an opportunity to to take the product afterwards, and had really good feedback. It was kind of just really positive. Just positive feedback for me to continue kind of looking into this because I have, I feel like a sense of efficacy. So

yeah, I mean, that's my anecdotal thoughts, too. I mean, I've tried it off and on for God, four and a half years now. I remember my, my buddy Cal Dietz coming up to me, probably six years ago now walked into his office. Hey, like, what are you doing? He's like, Oh, my new supplement for some of my athletes. I'm like, What is like gelatin? Like, gelatin? What the hell are you talking about? It's like, oh, it's for their joints. I'm like, huh, this is like, a long time ago. And I'm like, oh, yeah, he was kind of on the right track. Just a little off. But he was going in the right direction before anyone else was really thinking of it.

Yeah, no, it's it's crazy. Like I remember, you know, back in, I think the 90s. When I was in middle school, my dad was taking like Shark cartilage. And oh, yeah, remember that? Yeah. Yeah. So I mean, same concept, you know, he was a tennis player, and he was always struggling with like, kind of joint issues. And so, you know, he was always kind of trying out new things, always just new supplements, trying to help him improve his performance and his fitness level and stuff. So yeah, it's, it's been an interesting road. But I'm glad that there's a little bit of traction. And you know, it's gaining popularity. And I think people are pretty happy when they start taking it. So I figure why not figure out why it works. Yeah, you know, exactly what is it doing? So I'm really, you know, hoping that we see something novel and some of the blood that we're going to analyze over the next couple of months, and I'm excited to share the findings once you know, I have those.

Yeah, I think that'll be super interesting, especially if you find that it's like we talked about, it's not just a raw material, but it's setting off a bunch of these other processes that are going on just even like most research, right? You think you've got something sort of figured out? And then you've got like, you know, 100 more questions because of it. So

Oh, yeah, absolutely. I always say I'm like, you see one thing, either, you see, you don't see an effect, or you do and then that just opens up an entire Pandora's box for like, a whole new line of research. So

yeah, cuz people are like, Oh, you finished your PhD, you must have solved all the questions you have. Any more questions? Now's like the seven years before I even started it, you know?

Yeah. And I think that's that's the conundrum with like getting a PhD. It's, you know, kind of like, the more you learn, the more you know that you don't know anything. So

I remember telling Kyle, this once I'm like, the more I know, the more I know, I don't know anything. And pretty soon, I'll just know nothing.

I say something very similar to people all the time. It's so frustrating. So I'm like, Man, I study this so much. And just the more I study it, the more I know that I just don't know anything.

Yeah. Cool. Well, thank you so much for sharing everything today. We really appreciate it. And if you have any updates, we'd love to have you back on whenever.

Okay, thanks, Mike. It was a pleasure.

Thank you. Okay, bye. Thank you so much to PSI for coming on the podcast today. Really appreciate all for time, was awesome to talk to her again, such a wealth of knowledge. So if you have questions for her, she gave her contact information. So make sure to hit her up there. And thank you for listening to the podcast, really appreciate it. If you could do me a favor and subscribe to the podcast via whatever app you're using. That helps us out a lot. If you can leave us a review. However many stars you feel is appropriate. It works for me. You have constructive feedback, I'm down for that too. So anything and everything helps us make this a better program to help you reach your goals. So thank you so much. You can enroll and get information on the flex diet certification. Go to flex diet.com Fl exdt.com. Again, it'll open January 2022. And in the meantime you can still get on the waitlist and we'll put you on the daily newsletter to go to flex diet.com Thank you so much for listening we will talk to you again next week