[00:00:00] **Speaker:** Welcome back to the Flex Diet Podcast. I'm your host Dr. Mike T. Nelson. On this podcast, we talk about all things to increase performance, more muscle, better body composition, and even some longevity stuff, all without destroying your health within a flexible framework. Today on the podcast, we've got PhD candidate and soon to be actual PhD, Nathan Serrano.

And we're talking about a new review study that he published. And the American Journal of Physiology, Endocrinology, and Metabolism, entitled Muscle Fiber Phenotype, a culprit of abnormal metabolism and function in skeletal muscle of humans with obesity. So in translation, we're talking about looking at the muscle fibers themselves.

What type of fibers are they? Are they the slow twitch or fast twitch? And how does this relate to metabolism? Use of fat, use of carbohydrates in people with obesity and how is that different? And what I find interesting about this conversation is we learned some cool stuff. That if you have a high amount of fat next to the muscle or what's called intramuscular triglycerides If you are not moving around a lot, then this can be an issue.

Ironically, if you are an athlete, then it might be completely normal. And also that the fat stored next to the muscle in people who are untrained actually messes up carbohydrate metabolism and insulin signaling. A lot of times we think that it's just more carbohydrates are bad and actually has to do with the flux rate.

of how much your body is using the fat that's stored next to the fibers themselves. And then we talk a little bit about some cool research he's got coming out looking at muscle protein synthesis. So how well you can take amino acids and add them to muscle tissue. He did a study looking at this, comparing them overnight, fasted and fasted after comparing it to an obese population versus a healthy population and a whole lot more.

Those are super interesting conversation. We do get a little bit nerdy and down in the weeds, which is always fun. And if you enjoy this and want more nerdy goodness, you can check out my newsletter. And the best way to get that is via the Flex4. So go to miketenelson. com forward slash F L E X, the number four.

And that will subscribe you to the daily newsletter. And you'll get the exclusive content from this interview and past interviews about four questions that are not included on the podcast. So on this one, I asked Nathan, What would be the top four things If someone is currently not training, what would be his

recommendation for the top four things they should do to improve their body composition and health?

So you can get that at the Flex4. So go to Mike T Nelson.. com forward slash F L E X, the number four. We'll have a link down below. If you're already on the newsletter, then you will get it sent to your email automatically once this podcast is out and you'll be able to listen to all of the other flex for questions exclusively.

Also brought to you by Tecton ketones. If you're looking for a tasty ketone beverage check them out. They actually taste really good. Each one has 10 grams of a ketone ester included in it. And we'll put a link below.

I am a scientific advisor to them and an ambassador. So full disclosure on that. So enjoy this podcast with Nathan Serrano.

[00:03:54] **Dr Mike T Nelson:** Welcome to the podcast, Nathan.

I appreciate your time.

[00:03:57] **Nathan Serrano:** Yeah. Thanks for having me.

[00:03:58] **Dr Mike T Nelson:** Yeah. And we'll just jump right into it. You published a cool new study that I saw that I think Andy Gelpin retweeted. And I was like, Oh, that's pretty cool. So I contacted you and I'm like, Hey, you want to be on the podcast and talk about it?

You're like, yeah. So here we are. And tell us a little bit about it and all the background and the cool stuff.

[00:04:22] **Nathan Serrano:** Absolutely. Yeah. Again, thanks for having me. I really appreciate the opportunity you. to come on and chat

about this research. Like you said, he had Dr. Andy Galpin tweeted about this a while back and got a little bit of traction with a few people that follow him, so.

Nice. Thanks to him. He's got two followers

[00:04:42] **Dr Mike T Nelson:** now, so. Yeah, exactly. Yeah. I give Andy shit all the time. I've known Andy for years, so he's awesome.

[00:04:49] **Nathan Serrano:** Yeah. Yeah. So I guess a little bit of background on myself. I'm in my final year of my PhD. I'm currently at Arizona State University. I did my master's degree with Dr.

Andy Galpin at Cal State University of Fullerton. And then before that I was at Boise State University for my undergrad. Oh, okay. Both my undergrad and my master's degrees are both in exercise science and then my PhDs that started out as being in exercise and nutritional sciences. Long story short, for the sake of this podcast, I just transferred over to the biology program.

My advisor ended up having to leave, so, I just went with another advisor and now I'm in the biology program. Still studying the same stuff, still looking at muscle physiology human physiology, stuff like that.

[00:05:40] **Dr Mike T Nelson:** Who's your advisor currently?

[00:05:42] **Nathan Serrano:** His name is Christos Katsanis. He's done a lot of work in muscle protein synthesis.

Oh, cool. So, yeah, so he was one of the few initial investigators to look or start using stabilizers that we've seen as a tracer for studying muscle protein synthesis. Nice. Yeah. And so I've been here for four years. We've been looking at human obesity and muscle protein synthesis.

And then I brought my expertise with muscle fibers and we started diving into What regulates muscle myosin heavy chains if your audience at all follows. Explain a myosin heavy chain to people. Hey,

[00:06:22] **Dr Mike T Nelson:** what the hell is that? Exactly,

[00:06:23] **Nathan Serrano:** so if your audience is at all up to date with Dr.

Handy Galvin's work, I know you talked about muscle fibers quite a bit, and I'll give you the background. Yeah. So, Most people understand that we have fast and slow twitch muscle, and so within those two we have the main contracting proteins, myosin heavy chain and actin that most people hear about that are going to be the main proteins that are involved with muscle contraction.

And so these myosin heavy chains are the ones that we look at because those are going to dictate how quickly or how powerful the muscle is able to contract. And so we have slow type muscle fibers that will have one myosin heavy chain called one. And then the fast fiber types have what's called 2A myosin heavy chain and 2X myosin heavy chains.

And those two, both of those are pretty common. Quite a bit faster in their contracting velocities, and so we call this fast switch. With the 2x being like extremely fast and very rarely found in humans.

[00:07:20] **Dr Mike T Nelson:** Yeah, you actually see those in a D trained population, is that correct?

[00:07:25] **Nathan Serrano:** That is correct.

So we do see that in D trained or sedentary populations. We also see those in some diseased populations like renal failure populations. And we also will see that in there's been studies in simulated unloading to simulate space travel, right? And 2X tends to pop up a little bit more in those populations as well.

[00:07:46] **Dr Mike T Nelson:** Did they, as a sidetrack, did they know why that is? Because that, that always seems very counterintuitive. It's hey, let's let's put you on bed rest or toss you into outer space with no gravity or Have you not move around much, but wait a minute. You get like this super fast muscle fiber type.

[00:08:02] **Nathan Serrano:** I don't have a great answer.

Cause that's something that I'm trying to answer myself. I haven't really come to much concrete evidence for why that is. Other than any type of loading in the muscle is pretty good about sensing tension, mechanical tension. And so, any level of mechanical tension that's being sensed almost immediately shuts off this 2x gene.

And so, I think the thought would be, during these periods of unloading, there's nothing to inhibit that 2x gene, and so it ends up being the protein that gets made more because of just sheer elevation of what's in the pool of The chickens that are floating around. So that's my, that's my guess, but I don't have data.

[00:08:58] **Dr Mike T Nelson:** What do you think of my wacky idea that If the body is programmed for survival, maybe this 2x fiber type is like the last of the redundant systems. It's Hey, if you're going to unload us, we're going to have

this 2x that's going to appear just to try to save us for doing a sprint for one last time or something.

[00:09:18] **Nathan Serrano:** Yeah, that's definitely a theory that's popped up in the literature as well. Thought to be our survival tactic. Reserving some level of a fight or flight response,

[00:09:26] **Speaker 2:** right?

[00:09:27] **Nathan Serrano:** So our muscles are still able to meet the demand of having to flee and so that's a pretty common evolutionary biology type Theory for why we have these two x fibers lingering around in periods of inactivity So one of those

[00:09:46] **Dr Mike T Nelson:** theories it's really hard to get to why it's like we can show that this happens routinely but trying to Run an experiment to determine why I, yeah, I haven't come up with anything on that.

[00:10:01] **Nathan Serrano:** Yeah, it's so tough because for one, you'd probably have to put people on bedrest and it's hard to find people that would voluntarily put, be put on bedrest for periods of time like that.

[00:10:11] **Speaker 2:** Yeah.

[00:10:12] **Nathan Serrano:** You have to do all the omics probably to probe everything and then try and narrow it down after that.

All of those are very difficult. Time consuming and pretty expensive.

[00:10:22] **Dr Mike T Nelson:** Yeah. And even then, if you show that it happens, unless you find some weird Olmecs pathway that you didn't know it there, which is entirely possible. Yeah. You're left with, Oh yeah, it's a thing,

[00:10:32] **Nathan Serrano:** yeah, exactly.

Exactly. That's where I'm landing at the current moment. So it's it happens. I can't really pinpoint why, but I know that this happens.

[00:10:43] **Dr Mike T Nelson:** Yeah. Cool. Well, I detracted you from your your explanation there. We were talking about heavy chains and then I distracted you. Right.

[00:10:49] **Nathan Serrano:** Yeah, no worries.

So yeah, so, so, myosin heavy chains are the main contracting proteins that it dictates our muscle performance. And so flow push muscle fibers are often associated with endurance training or fast fiber types are more often associated with strength training, specifically the 2A fiber types. And so if you are training for a marathon or kind of your recreational distance runner, you're going to have a lot more of these slow fibers. These are, they tend to be more abundant in things like mitochondria that help give us energy for these workouts. Blood supply, there's more capillaries around these muscle tissues.

And so they're more equipped to sustain physical activity for long periods of time. And then the 2A muscle fibers. Can have similar amounts of mitochondria around, they can have similar amounts of blood supply but it's still less than type 1. The 2x ones are the ones that really diverge and are far less equipped with things like mitochondria and blood supply and enzymes that are good for synthesizing our energy ATP.

And so that's why. 2x is generally thought of as being a little more disappearance of a fiber type. Not as many beneficial outcomes that are associated with those where it's 2a that type 1s are. And so in my current research, we do a lot more kind of clinical work looking at obesity, type 2 diabetes. And so we look at mostly myosinib between 1 and 2a for those reasons. Is that good enough background?

[00:12:25] **Dr Mike T Nelson:** Yeah. And I think for listeners also type one fibers tend to be very small in diameter because they're relying on primarily the aerobic process of oxygen to diffuse across where two way, you can have more anaerobic metabolism if I'm just using colloquial terms here.

And you can have a fiber that's a little bit bigger cause you don't have to have oxygen diffuse all the way, into it.

[00:12:48] **Nathan Serrano:** Yeah. And actually we've seen people, individuals that have. pretty large type ones. And you can see this in bodybuilding. Theory behind that is they're doing higher rep ranges. And so they're still having to be equipped with robust mitochondria, robust blood supply, robust enzymes that are going to sustain them through those really grueling training sessions. But they're also going to have massive two way hybrids. And so relatively speaking, the two ways are still going to be bigger than the type ones in that scenario.

But type ones tend to be a little bit smaller.

[00:13:28] **Dr Mike T Nelson:** And that matches the conversation I had several years ago now with Dr. Brad Schoenfeld, where he was hypothesizing that high rep stuff, Nick Bird's done some stuff with 30 percent to 1RM and some other interesting stuff, blood flow restriction too, that his hypothesis at the time was that doing this higher rep work, You could see significant hypertrophy and type one fibers and I think there's been Some data that's shown that to be true which kind of matches what you were talking about, correct?

[00:13:58] **Nathan Serrano:** Right, and actually I got those, from brad Cool. Yeah.

[00:14:02] **Speaker 2:** Yeah.

[00:14:03] **Nathan Serrano:** So definitely credit to him and the stuff he's put out in the last 15 years or whatever yeah tons of great stuff. Yeah . I totally lost my train of thought, but yeah, so,

[00:14:14] **Dr Mike T Nelson:** so we can have some hypertrophy of type ones, but still mainly type two

[00:14:18] **Nathan Serrano:** type.

It's mainly type two. Two X is. It's said to be like the larger one, but basically it stepwise goes up with the fiber types of myasine butane. One tends to be the smallest, 2a, and then 2x tends to be larger. That's not always the case either. If you look at some of the literature, there's a lot of great examples of 2x fibers being the smaller one.

Not sure why this is the case, but it can go basically, all of these things are on a continuum, right? So Mycenae butane these fiber types, they can exist in, in multiple forms and their sizes are going to vary as well. So to say one fiber type is really one size or I think it's.

Maybe a over simplification of what our muscle can actually do. But along those lines I think it's important to also mention with this background of fiber types that we don't just have those three categories. We do have these kind of in between fibers we call hybrids that are going to have slow type and fast type properties.

So. These hybrids will often, you'll see the type one two A or two A two x, there's other types as well. There's one, two A, two X. You see all three Mycin, EBOT ice forms in them or one, two x as well. And so all of these things are

gonna exist in this continuum. So, I guess take some of these fiber type associations with a grain of salt, because at the end of the day.

Our muscles highly plastic is very highly variable as well. And I haven't seen anything that really solidly states, that these muscle fiber types are set in stone. And so I think that's great. Maybe for your audience to exercise a lot. Your fiber types going to change. How quickly that can happen.

Not very fast. It's going to coincide with how quickly we turn over tissue, which is pretty slow. So talking about muscle protein synthesis, as we turn over our proteins or break down our muscle tissue and then replace it with new proteins that's happening maybe at 0. 2 percent per hour.

So it's I think, is it like 3 percent a day or something like that? So over the course of a couple of months. You'll see your muscle tissue being fully overturned, but I think it's like

[00:16:51] **Dr Mike T Nelson:** 30 to 90 days now, isn't it? I think that was some of the studies that he did with some stable isotopes that I can't remember exactly what it is, but it's not super short, but it's, I think it's a lot shorter than what most people would realize.

Cause I think most people are thinking of the body as this sort of semi static thing, cause you look at your right bicep and you're like, Oh, it's still looks like my right bicep. Like you, if you're trying to make it. Bigger, it takes a long time, but the amount of turnover that's going on in the background, in my opinion, is crazy high it's higher than what I would think I guess

[00:17:29] **Nathan Serrano:** yeah, I say it happens slowly mostly to remind people that progress happens pretty slow with exercise.

[00:17:36] **Dr Mike T Nelson:** Oh, definitely

[00:17:38] **Nathan Serrano:** But it is I would say surprisingly quick it turns over and you know between two to three months

[00:17:46] **Speaker 2:** Yeah, which is

[00:17:47] **Nathan Serrano:** pretty quick. I guess in the grand scheme of things. It's pretty quick. And so muscle tissue is one of the More fascinating tissues to me, and obviously I'm biased, but it's because we're turning it over constantly, and so every few months, right, we have brand new muscle tissue as

long as we're, exercising, eating, and all that stuff and so, I think that also highlights, our ability to then change that muscle tissue as we're doing our, whatever lifestyle changes, right, so if we're just starting on an exercise regime regime, then, give it two, three months, and you will see some progress, and give it another two, three months, you'll see some more progress, so, yeah to me it's fascinating how quickly that can turn things around for you.

[00:18:33] **Dr Mike T Nelson:** Yeah, because to me, it's crazy to look at your, say, your right bicep, and then go, in three months literally almost all that muscle tissue has been replaced. Yeah, to me, it's still well, and the fact that it looks the same, right? So you go down this rabbit hole of, maybe spending too much time thinking about this, that with all the turnover rates, I think Van Loon did one study of looking at protein turnover rates in the brain were like 30 days or something crazy, but yet changes to the systems is still relatively slow, right?

If the maximal rate you could add muscles, maybe what? 0. 5 to one pound per month, somewhere in there. If you're.

[00:19:13] **Nathan Serrano:** Yeah.

[00:19:14] **Dr Mike T Nelson:** Natural athlete and that's probably on the high side. Right. Bone turnover, like in terms of gaining bone is very long. But yeah, it's always fascinating to me how the turnover rates are high, but yet we tend to look the same month in and month out, even if we're aggressively trying to add lean body mass.

[00:19:31] **Nathan Serrano:** Yeah. Yeah. Yeah. It's interesting. how quickly it seems to happen but how, like how subtle the changes like visibly are. So I guess back to this review paper that we put out we're looking at muscle fiber type. That's been a huge interest of mine since I was working with Dr.

Andy Galpin. And so going into my PhD work We're looking at these protein synthetic rates looking at mice and heavy chain specifically with an obesity mainly because there seems to be a reduced rate of protein synthesis in individuals who have a higher BMI or higher body fat percent.

And so the question obviously is, why is that happening? We don't fully understand why. We're still running clinical trials trying to figure it out. But one of the things that we did find that was interesting is that when you infuse amino acids, maybe not super interesting at this point, but when you infuse amino acids that are building blocks for proteins these individuals, this population tends to basically close the gap on their protein synthetic rates.

So if you compare obese individuals with lean individuals, obese individuals at rest are going to have a lower synthetic rate, but when you give them amino acids, they make up that gap. If you have them exercised, so now the question was, okay, well, when is this window that you need to give these amino acids to individuals? Is it pre exercise? Is it post exercise? Well, first, we've got to see, is exercise giving them any amount of protein synthesis on the bone? The answer is no.

[00:21:20] **Dr Mike T Nelson:** Really?

So they don't get a bump from exercise? Because for comparison, correct me if I'm wrong, but lean, healthy individuals would get a bump for 24, 48, maybe 72 hours, depending upon the study, the group, et cetera.

[00:21:34] **Nathan Serrano:** Right. Yeah. So I, the only thing I would say with that is the time points that we measured are may not have measured far enough out.

We've measured at four hours. No, that's pretty long

[00:21:46] **Dr Mike T Nelson:** though. Right.

[00:21:47] **Nathan Serrano:** It's pretty long, and we would have expected to see something there, but we didn't see any increase in both groups. And so, again, this is in kind of an effective state. This is an effective state, so these are essentially what we drew it up to being as just having a lack of amino acids in kind of the pool to grab from, to recycle and start building these proteins.

And so we didn't see a bump after exercise. What we're currently doing is now we're Doing exercise and amino acids to see if that gap still is being closed, or it's an even more robust signal.

[00:22:23] **Dr Mike T Nelson:** So just so I'm clear, so you had people come into the lab overnight, they were fasted, You didn't use an You had them do some exercise, and then they stayed fasted for up to four hours.

And in the obese group, you didn't see any change in muscle protein synthesis, correct?

[00:22:40] **Nathan Serrano:** Right, right, right.

[00:22:41] **Dr Mike T Nelson:** Got it.

[00:22:41] **Nathan Serrano:** Yeah, so we didn't see any increases compared to the lean as well. So, the lean individuals also didn't show that increase. And so, that tells us that there's obviously, there's a lot of nutrients there to actually stimulate or be able to carry out.

Great.

[00:22:56] **Dr Mike T Nelson:** Oh, so the lean group didn't see a bump either.

[00:22:59] **Nathan Serrano:** Yeah, so it's likely that protein breakdown may have also just been exceeding the synthetic rate. We didn't measure breakdown but again, this is an acute study so it's tough to measure everything That are, would show whether or not overall protein is being built.

[00:23:19] **Dr Mike T Nelson:** But Because this is the working theory in a lean, healthy individual that you would be able to take some amino acids out from the amino acid pool that's floating around in the blood and kind of redistribute

[00:23:30] **Nathan Serrano:** them. And so, that is the thought.

[00:23:38] **Dr Mike T Nelson:** Theories don't always play out in experiments.

[00:23:43] **Nathan Serrano:** Also, again, this is more of an acute it may have just been that the stable isotope wasn't being infused for a long enough period of time to catch those subtleties, which is obviously a downfall to using stable isotopes. You can use something like doubly labeled water where you can track it for over several days and see that subtle change a little easier.

But with that said. Yeah, we haven't seen any increases in proteins of this in these individuals. And so now our current clinical trial is looking at amino acid infusion and exercise. And so what we had them do, they came into the lab, fasted we gave them the stable isotopes so they can track, then they did a bout of exercise and then immediately following that exercise, we gave them the amino acids and we're going to be measuring at

[00:24:30] **Dr Mike T Nelson:** Was that amino acid infusion?

Or was it like a protein shake orally? It's an

[00:24:35] **Nathan Serrano:** infusion, yeah. To make it easier on it. Sure. Although I'm sure they would be pretty excited to be able to consume

something at that point because they're fasted for, Close to 14, 15 hours. But that data hopefully will be out in the next year or two.

We'll see what happens with that one. So with that in mind, we wanted to write this review paper that was looking at what's the association of My name is really set the stage for all these associations and muscle fiber types and different outcomes or characteristics that we tend to associate fiber types with so things like mitochondria lipid accumulation protein synthesis, and so all of these things set the stage for muscle fiber types as being the culprit of.

Driving metabolism in a way. And so, what we say in the paper is basically that these muscle fiber types, they're making up X volume of your muscle. So we use your thigh muscle as an example. And typically, when we do these studies we'll give a percentage of myosin heavy G content muscle fiber content, right?

So you have, 50 percent type one other 50 percent type two, a for simplicity. Well, then that would. Theoretically meaning that 50 percent of the volume of your thigh muscle is type 1 and 50 percent of the volume of your thigh muscle is type 2a. Could be the case when we're looking at muscle fiber types with, single fibers and you're tweezing single muscle fibers under a microscope and then you're measuring myosinema chain.

You're not exactly testing for muscle fiber size. They miss that. So we don't always associate single muscle fiber distributions with the muscle volume. But what we can say is, the more of these fibers you have, the more likely it is that they're encompassing more volume of your thigh muscle.

And so because of that larger volume of that specific muscle fiber type. You're going to have more characteristics of that fiber type. So, for instance, type 1, you're going to have, if you have a higher percentage of type 1s, that's more volume taken up of your within your muscles. That's going to be characterized as all those things that I mentioned earlier.

Mitochondria, capillaries, enzymes, all those things. And so that's going to impact your metabolism. Where the paper starts to make a little bit more of a Pointed argument is how that impacts, right? And so, there's a lot of research out there that shows that obese individuals tend to have less type one which means that there would have to be an increase in these fat fibers. We're looking at just content attributions. Then that means 2a would go up, 2x would go up. We already mentioned that 2x is pretty deleterious to a lot of outcomes. And so, This review paper is basically setting the stage for that for us to then hopefully

soon at the end of my dissertation, I should have more data to show with that what's happening on the side of 2X.

And so we would hypothesize that because type 1 is going down and sedentariness and obese individuals being more likely to be more sedentary, it's not always the case, but it's they tend to be less active. Then we would expect these two fibers or fat fibers overall to increase. Along with that comes with things like increased accumulation of fat within your muscle tissue.

We know that to be deleterious to muscle quality. I use the analogy of marbling, right? So for those of us who eat meat still marbling looks nice on the plate. Not too great for muscle quality and our muscle performance. So the more fat you have within your muscle the more damage you're allowing to happen because you're having to use all those fats.

Those fats have signals that are sent out to the body usually in the form of inflammation things of that sort. And so, things get interfered with that wouldn't be more normal. Things like insulin signaling, right? So insulin is needed to bring in glucose from your bloodstream from your meals.

It's also gonna transport some fats as well around the body as they're being used. But if you're not using those fuel sources, they're just sitting there being stored. We get increased body fat.

[00:29:03] **Dr Mike T Nelson:** And so which I think is an interesting point because I wouldn't say a lot of people but a lot of people on the the old internet I would say that, Oh bro, it's just carbohydrates.

You eat too many carbohydrates and that's messing with your insulin signaling. But when you look at the literature, at least in an untrained population, it's exactly what you said. It's the intramuscular triglycerides get bigger and correct me if I'm wrong, but there's no flux through them.

And it's just like a storage depot for fat where Some high level endurance athletes, you still have some intramuscular triglycerides, but they don't seem to have as negative effect because you're literally storing some fat there, but then you're oxidizing or you're burning it on the other end.

So you have this turnover and this flux of fat kind of going through it, and that doesn't appear to be as detrimental.

[00:29:56] **Nathan Serrano:** Exactly. Yeah, there's actually some really interesting literature. Seems paradoxical at first,

[00:30:02] **Speaker 2:** right?

[00:30:02] **Nathan Serrano:** Kind of to your point, endurance athletes will have more of this intramuscular fat, but they are cycling through it pretty frequently because they're obviously working really hard, they're doing their training.

Either that or if you're doing a marathon, you're burning through all of the fuel sources that you have stored in your body.

[00:30:19] **Speaker 2:** Yeah.

[00:30:19] **Nathan Serrano:** So, your muscle is going to draw from that. But if you're, you're not active you're sitting on the couch and not doing a whole lot of activity, then those depots, the storage depots of fat and sugars get filled up pretty quickly.

And then it goes elsewhere. In the form of basically fat around your organs or visceral fat. We know that to be extremely deleterious to your health. And so, that's another thing to consider when you're talking about muscle performance, fat accumulation, stuff like that, and even diabetes. Is there Mainly, and this is probably going to be not too popular with the internet, but

[00:31:10] **Dr Mike T Nelson:** it sounds good

[00:31:11] **Nathan Serrano:** then, right?

Yeah. But these things are it's just a lack of activity. If you are using your muscle and you're burning through the fuel sources, they're not going to be stored. Or on the other side of it, if you don't bring in excess of those fuels, then they're not going to be stored. Right. And it sounds maybe oversimplified, but it really is that simple.

If you're using those fuel sources, they're not going to be stored. Where it comes, where it be, starts to become more complicated, which is probably a little more of a discussion maybe beyond this podcast, is the behavior behind it. The behavior, I think is a very real barrier for a lot of people. And so, whether that's socioeconomic or otherwise and it starts to muddy the water a bit.

It's a little more complicated to get that, but at the end of the day, the equation is very straightforward. We've known this for a long time. It's calories in versus calories out.

[00:32:09] **Dr Mike T Nelson:** Yeah. And it's crazy to me how, if you're in a massive caloric surplus, how much that will start to mess things up and you get an extremely protective effect from exercise as long as you can keep scaling exercise, like there's some studies in sumo wrestlers.

And I think some NFL linemen that show metabolically, they're actually pretty good, but the second they stopped training and they stopped having that high background of exercise, they go to shit real fast. Because they have this huge caloric excess, so they don't have this massive exercise buffer. And on the flip side, a caloric deficit makes up for a lot of other weird ills, too.

Because you just literally don't have as many things that you need to stuff somewhere else that they shouldn't go.

[00:32:55] **Nathan Serrano:** Yeah, you're not demanding a bunch of different shuttling things that either are helpful or not helpful. Okay. You're just reducing the stress on the system by doing caloric restriction to a point, obviously.

[00:33:12] **Dr Mike T Nelson:** Yeah, you don't want to, Hey, I'm going to drop to 500 calories a day or fast for four weeks or crazy stuff. Yeah,

[00:33:18] **Nathan Serrano:** Exactly. But yeah, that's more or less the kind of broad idea behind this paper is that like, all of these things can in some way be linked back to muscle fiber types.

And muscle fiber types are probably impacting metabolism to a greater level than they've previously been thought to. Oftentimes people have treated muscle as this this mechanic, strictly mechanical tissue. We know that's not the case anymore. We know that there are signals that are being thrown around the body that are talking to other tissues, other organs.

We call these myokines. And so those things are communicating with the rest of the body. Hey, we need this. Bring it over here. Hey, we need that. We don't need this. You can have that. So things like lactate, right? Lactate gets shuttled around the whole body during exercise. And one of the things I always talk to undergrads about is Do some genuine exercise where you get that burn, where you're getting lactate buildup and then work another muscle group out and see how quick, how long that can actually be sustained.

Like you'll feel you can do like a massive not massive, but you can do a substantially longer bout of exercise after pre loading your body with some lactate because you're using it as a fuel.

[00:34:40] **Dr Mike T Nelson:** So the theory there is if I want to go out and, do some Do 30 second wind gates on the rower for repeats.

And then I'm going to go do some bicep curls. The theory is that because the bicep curls weren't really worked all that much, I did a bunch of wind gate stuff. So I'm producing a ton of lactate, lactic acid, which gets to be lactate and hydrogen ions. But then because I'm doing a muscle that wasn't necessarily worked as much, I've got high levels of lactate floating around.

Which is a high energy fuel to actually do more work on my bicep curls, for example. Is that correct? Right.

[00:35:20] **Nathan Serrano:** Exactly, yeah. And so, I talk to undergrads about things like the hollow timing, so, things like Loctate, things like

[00:35:28] **Dr Mike T Nelson:** So, you're saying Loctate's not evil.

[00:35:30] **Nathan Serrano:** Exactly. Loctate's definitely not evil, and it's definitely not sitting in your muscles for more than, a couple hours.

Bro, this is not what's going to make my muscles sore. Exactly. That grinds my gears. I was teaching teaching assistant for anatomy physiology. Every time I go over muscle physiology, I make a huge point. Lactate has nothing

to do with your fatigue. It's hydrogen ions. It's a lack of fuel. It's pH, maybe.

[00:36:03] **Speaker 2:** Yeah.

[00:36:04] **Nathan Serrano:** Or it's calcium and potassium kind of imbalance. Right. So those things are going to contribute to your fatigue more so than lactate ever was thought to.

[00:36:14] **Dr Mike T Nelson:** What are your thoughts about lactate as a supplement?

[00:36:17] **Nathan Serrano:** I don't know. I haven't really looked at or looked into that very much. Nor have I really heard of it being a supplement very much. I don't know. If you have, I would love to hear about that.

[00:36:33] **Dr Mike T Nelson:** Yeah, this is one of my pet theories for like almost a decade now. And so for the first, like six years, I had NDAs with companies and just trying to get them to buy out.

And everyone's you're insane. This is a stupid idea. And then about four or five years ago, I just gave up and I'm just like, Hey, someone go do this, please. And yeah, there's been a couple of studies that have been done with mixed results the lactate that George Brooks originally had with right side of Is off patent now.

Okay. My understanding, the amounts that have been used in most supplements, I think are too small. Calcium laxate is off patent, so you can get that. I've played around with it a little bit, but I think the rate limit, or like with ketones, or like at least beta hydroxybutyrate is, what are you attaching it to, to get it across the intestine?

[00:37:22] **Nathan Serrano:** Right. Yeah. You

[00:37:23] **Dr Mike T Nelson:** know, you're probably going to need A pretty hefty dose and then the early ketones if you only attach it to sodium Well crap now you've just loaded your gut with this huge amount of sodium which can cause disaster pants I may have experienced that with the early versions but again, you could split it across different ions if somebody patents us, please at least include me.

Thank you but anyway Because in theory, it, the PKA makes sense, it does appear to be, when it's bound to an ion, it does appear to cross the gut, it does appear to show up in the blood, we can easily measure it in the blood, and if you can get high levels of lactate without the pesky hydrogen ions, Your brain loves lactate, your heart loves lactate, your muscles, they want to use lactate because it's a high energy fuel that's already there.

It's just normally it's produced at the same time as these high levels of hydrogen ion that bugger everything up. So anyway, that's my little spiel.

[00:38:22] **Nathan Serrano:** Yeah, no that actually reminds me that, so I know a couple of George Brooks current PhD students talked about the studies that they've done with these lactate supplements. And yeah that's the first thing that always comes out of everybody's mouth is how's your bowel? Yeah. Yeah. and

[00:38:42] **Dr Mike T Nelson:** so yeah, just his lab's done some from that Yeah. Stuff with TBI and actually lactate infusions, I believe. Correct, yes.

[00:38:48] **Nathan Serrano:** Yeah, I think they, they would recently published some of that work and they're also looking at like post lactate in the gut.

Something along those lines. But yeah.

[00:39:01] **Dr Mike T Nelson:** Yeah, so anyway, if someone does develop that let me know, or, I don't know, send me a percentage, whatever Because I'm just curious because it, just because how was it Peter Lemmon said just because it's logical doesn't mean it's physiological.

Yeah. A lot of stuff that like we think works good on paper, like you could go down the list of God, we've probably tested what every other Krebs cycle intermediate from pyruvate to citrate to whatever. And. Most of them are a bust, creatine, the rare one that was beta alanine, maybe different mechanism, but all the other ones, you could have this laundry list of bro, this should work because the word enters here and you got more of this and that.

And they didn't really pan out. Yeah. Yeah. Very cool. And if you were to go out on a limb, if you are someone who is not very metabolically healthy and we would hypothesize that maybe you have more. Intramuscular triglycerides that are gumming up the works in the muscle. Would you be a fan then of an intervention of fasted cardio?

To try and target and increase the flux through those intramuscular triglycerides to try to combat that? Obviously, Blorek deficit would be number one, but

[00:40:21] **Nathan Serrano:** I

What I'll say is on paper, it seems like that would but what I would probably recommend more so than anything is doing exercise that depletes your muscle of the most glycogen as possible.

[00:40:39] **Dr Mike T Nelson:** That was my next question. And why would you pick that?

[00:40:44] **Nathan Serrano:** I would pick that because that sensitizes your muscle to insulin.

So that, that protects you from becoming insulin resistant. And so the more often you can do that, you're going to burn through those triglycerides. Yeah. It's not a question of if, it's a question of when, and so if you consistently do glycogen depleting exercise, you're probably going to be on the same track.

I don't know for sure if or how well doing facet cardio burns through triglycerides off the top of my head, but you're going to get a similar effect. Is it, now, this is where it gets a little bit muddy, is glycogen depleting exercise is pretty.

[00:41:30] **Dr Mike T Nelson:** That was my next question. What are you going hardcore where you're like under 50 grams of carbs a day and doing exhaustion stuff, or are you doing like the exhaustive work, like the sleep low studies where you just get a little bit of protein and you come back the next day faster and you hammer the same thing again.

[00:41:49] **Nathan Serrano:** You can do something like that, or you can do long duration exercise goes through a good amount of, I'm not talking about full depletion, but You've got to stimulate some level of glycogen repletion at the end of the day. And so if you're able to stimulate the replenishment of glycogen into your muscle tissue, you're still stimulating insulin.

And then couple that with being in the caloric deficit or at least within maintenance. And not excess, then you're going to be on the right track.

[00:42:24] **Dr Mike T Nelson:** So if you had a program exercise to do that what would you program just so people have an idea? And I know we're getting pretty hypothetical here, but,

[00:42:34] **Nathan Serrano:** So I'm not a huge proponent of any one type of exercise or any one exercise is the best, and I tend to try and program individuals to do physical activity that they're able to sustain as

Because they enjoy it, not because totally they think it's good for them or whatever, because that tends to just create a bad habit of desing the activity that you're doing.

And then it just doesn't work out long term. Your

[00:43:02] **Dr Mike T Nelson:** body's not gonna wanna do a lot of stuff you hate. Exactly.

[00:43:05] **Nathan Serrano:** So if I can find some type of long duration, sustainable exercise that they can do twice a week and couple that with maybe some HIIT training once a week. And then some strength training.

I think I don't want to fall back on all of Dr. Engelman's words or all of his words, but he does say something along those lines where you should do long duration exercise one or two times a week, hit exercise once or twice a week, and then strength training three, four times a week. Do stuff that increases your heart rate as often as possible.

And I think you'll see. Things start to clear up pretty quickly. And so that's my general recommendation. Obviously, we're getting into kind of more details. You can look at, length of intervals, interval training is by definition more like one to one and usually one minute to one minute or anything beyond that.

A lot of the HIT research at least is, starts there. You can look at SIT or sprint training, right? Sprint interval training. It's more of one to four ratio for rest to work or sorry, work to rest. Where it's really short periods of basically max out exercise. So if you're doing sprints.

On a track, probably don't want to do that on treadmill. That can be pretty, pretty hazardous. Yeah. I don't want to say a bike, maybe a bike. Bike works good. Rower works well, exactly. Or run on a track. And you can do it that way as well. That works pretty good. If you do enough of those you'll get pretty depleted.

You'll feel it. And so, we follow those I think modalities and Start to see some progress, I think, pretty quickly.

[00:44:56] **Dr Mike T Nelson:** And the cardio, the longer stuff, are you thinking like zone two or kind of more cardiac development zone three ish, or does it depend on the fitness level of the person?

[00:45:05] **Nathan Serrano:** I would say it depends on the fitness level of the person. Going by most most people will go by this to people like Peter at the TIA and swear by zone 2 being the best target for a lot of people. And I, on many levels agree with it but I also do this idea that There's the, what do they call it?

Gears, which is I believe Tucker Andy Galpin and Brian McKenzie. It's like nasal

[00:45:33] **Dr Mike T Nelson:** breathing, adjusting by nasal in, nasal out, nasal in, mouth in, mouth out.

[00:45:38] **Nathan Serrano:** Exactly. So I like those, the gear system as well. And I think, I don't think someone who is. Not while a custom taxi size is going to be able to do that very well.

They're going to stay probably in gear one for a while until they can get used to that sound breathing. Or really just learning what that even means. And so zone two for that case would work really well. But somewhere in the realm of probably zone 2, zone 3, or gear 2, being able to nasal inhale pretty consistently, I think it is pretty powerful.

And I think that's a good spot to be in for these long duration style exercises.

[00:46:21] **Dr Mike T Nelson:** Cool. Yeah. I, my biases, I think zone two can definitely be beneficial as someone's on, not really trained at all psychology aside, right? That's a whole nother issue of doing 40 to 60 minute bouts two to three times a week is probably what you need. I only tend to have people do it for six to eight weeks.

Again, if you're an extreme high end cyclist where you're training 18 frigging hours a week or something, then yeah, you're gonna probably have more zone too, but those people are all batshit crazy. And if you tell them not to do anything, they're going to go ride a bike anyway. So I have this theory that telling them to do zone two is just pure recovery work for them to stop doing high intensity stuff.

But then after that, I'm. I'm more a fan of what I would just say is the cardiac development, like in Brian McKenzie's system that would either be very fast, nasal in, nasal out, or nasal in, mouth out, because I just think you get better cardiac adaptations from there after a period of time. But again, that's just my own bias.

[00:47:22] **Nathan Serrano:** No, research is starting to finally catch up with a lot of these breathing protocols or breathing kind of frameworks around exercise. And I think we'll start to see a lot of that style of exercise being connected with your rhythm of breathing, where you're breathing from.

So I think there's a lot of power in nasal in nasal in nasal in, nasal out, and nasal in, mouth out. And I try to do that as often as I can when I am doing these longer duration exercises, I'll try to maintain nasal and nasal as long as I can

until I have to take a few mouth breaths, and then I'll go back to nasal and nasal. So I haven't programmed for people in that style just because I feel like it's tough to get a gauge of what people are ready for those types of things. At least in my case I'm not doing it in person with them. Then it's tougher for me to make those subtle changes. And they're like no, it's okay.

Like you can do some mouth breathing. Don't force yourself to pass that because you are only on nasal and nasal out. Yeah. A couple of mouth breaths. Catch your breath. Make sure you're not going to pass out and then keep going. So there are certain kind of subtle coaching cues that I would fall on that makes it tougher for those at least for me to really program with that. But I think in a general sense I try and stay towards, just do something that you can sustain for whatever time it is that you plan to be out. Give you an example. A client that I've been working with for close to 10 years now. Oh, wow. She's out in Alaska. She's a D.

O. out in Alaska and we've been working together for quite some time. She, I've given her kind of, I've thrown everything at her. She's been a little, she's been a little bit of my guinea pig at times, but I don't ever prescribe her. A very specific type of lung duration. It's always just pick something this weekend, go out for a hike, go for a bike ride, or just go for a couple of miles run.

Any, anything is better than nothing. It doesn't have to be a whole lot. With metabolic cardio, metabolic exercise, a little goes a long way. And a lot doesn't go that much further. So I'm like, just do one or two days a week and you're solid. So I don't tend to be a huge stickler on you have to do this distance or whatever.

I guess thinking more from a general population perspective, I think more people will get a lot more bang for their buck of just sticking to those two days a week, doing something long and sustained and generally sticking to some type of resistance training the rest of the days. And so that's how I approach most of my coaching.

[00:50:16] **Dr Mike T Nelson:** Yeah, very cool. I had a proposal. It's, I had an NDA, but it's so soon expired as here's a company that had a. I won't say the name, but it was basically a device where you could adjust concentric and eccentric contractions separately. So you could have different amounts of loads for them. You could have high concentric and no eccentric, or you could have a high eccentric, no concentric.

It was a motorized system. And so they were looking at it for treating people who are borderline diabetic. And so I wrote up a little protocol psychology aside, where. I just beat the crap out of people with concentric only work like just hammered the living shit out of them And my thought being I want as much muscle contraction as possible I don't want to make them ridiculously sore that they don't show up the next day Yeah, again and with the machine you could do that.

Yeah, any thoughts on that in terms of I love insulin sensitivity. I know it's very theoretical

[00:51:21] **Nathan Serrano:** Yeah, that would definitely be pretty theoretical, but I love the idea, but behind it, I think it seems like it would, both in practice and on paper, do a great deal for insulin sensitivity because you are, again, like you said, just hammering the muscle away without causing too much damage that they would be so sore that they don't want to continue.

That's the trouble with a lot of these kind of resistance training. Right. That studies is like you get these individuals starting to do resistance training and then they drop out of the study because they're too sore to continue or they think this is, bad for them because they're so sore. So yeah, that's a fantastic idea.

I really like the approach of doing most like basically concentric only. When I was doing personal training in person. We would definitely have a lot of, try to do like a decent amount of days of like concentric only movements just to keep people coming in. Not only that, it's pretty good to get people concentrically really strong without hammering on the tissues so much that they're getting some sort of overuse injury.

Because some of these are athletes, right? So some of the athletes, you don't want to hammer their joints with so much concentric eccentric that their engines are starting to get a little over stress or overused. And so I think concentric always, it's a great way to get around that.

[00:52:53] **Dr Mike T Nelson:** Yeah, I used to do that a fair amount when I had my train more people here at my house I didn't tell them this but I basically did what I call like concentric circuits So we would do like car push sled drag reverse sledge.

Yeah sledgehammer on a tire rower Maybe kettlebell swings if they're really experienced, but that could add some high eccentric to it so usually I would drop that but They would just repeat that circuit. That sounds

[00:53:19] **Nathan Serrano:** exactly like what we used to do. It's friggin hard. Yeah, it's so hard.

[00:53:23] **Dr Mike T Nelson:** They're not high skill movements.

So when you're fatigued, like you don't have to worry too much. Yeah, exactly. All the clients like loved it and you could beat the crap out of them. And amazingly, they wake up the next day and they're like, Hey man, I feel pretty good. And I was like, Oh, sweet.

[00:53:40] **Nathan Serrano:** Yeah. Yeah, no, that's definitely the style of painting that I would program a lot for general population just to make sure that their soreness was at least kept to.

a pretty low level and they all seemed to love it because it was like super grueling exercise pouring with sweat and oh my god, I was like, what is the best progress of my life? And then they come in the next day and look ready for more. I was like, okay, let's do it again.

[00:54:08] **Dr Mike T Nelson:** Cool, man. Awesome.

Well, thank you so much for all your work. I really appreciate it. Thank you for publishing the review study there. I'm super excited to hear more about your thesis once you can share all the information there. And yeah,

[00:54:21] **Speaker 2:** definitely. Yeah.

[00:54:22] **Dr Mike T Nelson:** Are you going to be at ISSN next week of this recording or not?

I know you're busy in the lab all the time. No,

[00:54:29] **Nathan Serrano:** definitely not. I don't typically go to ISSN. I usually go to ACSM or American Physiological Society. Oh, cool. Yeah. So I typically go to those. I'll probably start going to NSCA again soon.

[00:54:42] **Speaker 2:** Yeah.

[00:54:44] **Nathan Serrano:** But yeah, those are the main ones that I usually go to.

I'm trying to actually finish in July, so. Oh, awesome.

[00:54:51] **Dr Mike T Nelson:** You're getting very close. Super close. Extremely,

[00:54:53] **Nathan Serrano:** extremely close. So, definitely been in the trenches for a while now. So, yeah,

[00:55:00] **Dr Mike T Nelson:** I can honestly say my Ph. D. was by far the hardest thing I ever did. It was not only difficult, it's difficult day in and day out for friggin years.

It's just like this grueling endurance contest.

[00:55:15] **Nathan Serrano:** Yeah, I know. Yeah, but I'm glad to be so close to the end. It's just a matter of reaching that finish line now, so. I'm definitely ready for it to be over.

[00:55:27] **Dr Mike T Nelson:** Awesome. Well, all the best and where can people find out more about you? I know you've got some social media stuff.

You've got some other areas.

[00:55:33] **Nathan Serrano:** Yeah. So I always forget what my, whatever tags are for Instagram. It's probably not a bad thing. Yeah. Looking at them now. So it's going to be underscore Nate Serrano underscore, and then you can find me on Twitter. ARX, whatever you want to call it. That's going to be Nathan underscore Saron, so pretty easy.

Typically, you Saron, you'll see my picture somewhere. Yeah, those are the main areas that I don't post all that often right now. I'll repost certain things and certainly I'll make a post when this podcast comes out. But other than that, I'm fairly quiet these days on, on social media. With the occasional research paper here and there.

I'm probably more active on sharing research on FOX than I am on Instagram.

[00:56:21] **Dr Mike T Nelson:** Very cool. Well, thank you so much for all your time. I really appreciate it Thank you.

[00:56:26] **Nathan Serrano:** Thank you All righty

[00:56:28] **Speaker:** Thank you so much for listening to the podcast. Huge. Thank you to Nathan for coming on the podcast and talking all about his great research. We'll make sure to put a link to the study review that he did.

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Really appreciate it. And we'll talk to all of you next week.

Well, they say all good things come to an end. What's that got to do with this show?

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