

[00:00:00] **Dr Mike T Nelson:** Hey, what's going on? It's Dr. Mike T. Nelson here, and welcome back to the Flex Diet Podcast, where we talk about all methods and tactics to increase lean body mass or muscles slash hypertrophy, strength and performance, and better body composition, all without destroying your health in the process with a flexible approach.

Today on the podcast, I've got someone I think you'll really enjoy. I'd be willing to bet you probably haven't heard of him before. But one of the things I love about doing this podcast is people I've met in the past or at different conferences or people I think have just amazing information that you need to hear about, but don't do a lot of social media stick to their research or in the trenches practice.

And they allow me to interview them and ask 'em all my crazy questions. So this one is with Dr. Brent Ruby. I first met Dr. Ruby Pan going back, that's probably, maybe over a decade ago now, which is wild to think. I was doing a talk at DARPA, so Defense Advance Resource Project Agency. They are the people that do all of the crazy research for the military.

What's interesting about DARPA as a side note, is they are sort of a private entity, but they do use government funding. But they are not a government institution. So when I was there, I asked them, I said why is that set up that way? And their argument is, which has proven to be true, they wanna leverage the public sector private sector also, because all the companies and researchers that operate in that area have to already be up to speed.

So they don't have to spend time and money getting them up to speed such as some other government agencies. And the questions they're asking are questions that are 5, 10, 15 years out. So when I was there doing a talk, we were looking at for soldiers, what are ways to make them more reliable and different things we can do for testing.

So I was giving a talk on the metabolic flexibility. How you could potentially train up soldiers ahead of time so that they would be able to handle bigger stressors coming their way, be both physical or nutritional challenges. And so one of the other talks there was by Dr. Brent Ruby. So I got to meet him.

He's done a lot of really cool work. He obtained his PhD and exercise phys from the University of Mexico in the mid nineties. There he was researching using stable isotope tracers. Looking at the glucose production during exercise. So he has a huge background of the metabolism side and also metabolism in terms of extreme responses.

These could be athletes doing 24 hour or 48 hour or longer races. These could be people doing wildfire fighting in different areas, and some really fascinating stuff that he's done. And what I really enjoyed about this talk was if we understand what's going on at the extremes, that the extremes can then inform the means or the average.

Unfortunately, it doesn't work the other way. The average doesn't really tell us anything about what's going on at the extreme end of the spectrum. So you might be wondering why I have a lot of interviews with this. Like we had one with Dr. Jackson just last week. About looking at cold response in extreme environments.

I think this does give us some clues as to how your physiology operates because we are very much survival based. So if you want higher level performance, better body composition, and just to be more resilient, understanding how the human physiology operates at the extreme end I think is going to be extremely useful for you.

So enjoy this podcast here with Dr. Brent Ruby. And if you wanna learn more about metabolism and how it applies to the science of a better body composition and performance, the Flex diet certification will open again June 5th, 2023 for one week. And in it, I cover the eight interventions to do just that, to increase your performance and to have better body composition.

Everything from protein to carbohydrates to fats. To neat non-exercise activity thermogenesis and much more sleep, et cetera. And the cool thing about this is it's set up in a way that you will understand the theory of metabolic flexibility/flexible dieting. You will get a one hour lecture on the in-depth knowledge of protein metabolism, and it'll be explained in a way that you can understand it, but obviously it'll be very much based on the research.

And then for each intervention, you'll have five specific action items. To use with yourself or clients so you will know exactly what to do and how to apply it in each situation. So you'll walk away with the concept of metabolic flexibility and flexible dieting. You'll understand the big picture, you'll understand the details of each intervention, and you'll also know exactly how to apply it in each situation.

So check out the flexdiet.com. For all the information and you'll be able to get on the wait list there today. We'll have some cool bonuses that will come out beforehand. So enjoy this wonderful conversation here with Dr. Brent Ruby.

[00:05:46] **Dr Mike T Nelson:** Hi, and I'm here with Dr. Brent Ruby.

How's it going man? Thank you for being on the show

[00:05:51] **Dr Brent Ruby:** here. Yeah, it's going quite good. Thanks for having me.

[00:05:55] **Dr Mike T Nelson:** And you are out there in Montana,

[00:05:57] **Dr Brent Ruby:** correct? Missoula, Montana,

[00:05:59] **Dr Mike T Nelson:** yep. Yeah. And so for people who weren't familiar with Montana geography, do you wanna explain where that's at?

[00:06:06] **Dr Brent Ruby:** Yeah, we're about a hundred miles from the Idaho border, so we're on the west end of the state at sort of the foot of the Northern Rockies.

[00:06:16] **Dr Mike T Nelson:** Nice. Yeah. Beautiful area. I've been out there a couple times and my wife is from Montana, so we're big fans of Montana overall.

[00:06:23] **Dr Brent Ruby:** Yeah, there's lots of places to play. Lots of

[00:06:25] **Dr Mike T Nelson:** things to do. And what are your favorite outdoor pastimes right now? I know you do a bunch of different things.

[00:06:33] **Dr Brent Ruby:** Yeah I've lived through, I'm a recovering Ironman, so I've raised a gun over the last several years, over several years.

But just being out with the dogs on the mountains, just hiking and lots of trail running. And there's, I don't ride as ride a bike as much as I used to, but yeah, tons of great fishing, great hunting, pretty much anything outdoors. We've got it.

[00:07:00] **Dr Mike T Nelson:** Nice. And we, I think first met at the DARPA event, man, was that we're 13 years ago now, it feels like a long time ago.

[00:07:10] **Dr Brent Ruby:** Yeah. I, it was a long time ago. It was probably 15 years ago or so. Yeah. Yeah, I remember

[00:07:16] **Dr Mike T Nelson:** that. Yep. Yeah I still remember that as like probably one of. Craziest things I've ever went to and presented at the first thing was I couldn't find the freaking place. Like I was going all over and I even left like an hour early to make sure I wasn't late.

And then I'm freaking out about that, finally get it, find the room and everything went good. And even to this day, like that is probably the room full. Like some of the smartest people I've ever been in. I was like, oh man, I am the dumbest person in this room. Like by far. But it was a very cool experience.

[00:07:49] **Dr Brent Ruby:** Yeah. Those are, I've only been to that DARPA meeting. I've been a bunch of other army research meetings in there're Sure. Exceedingly well organized and really fun to go to. We've done a lot of research with the army and some of those meeting. Are just some of my favorites, just cuz it's a really focused deep dive into the different projects and you get a, you get familiar with the different projects that the different teams are doing and yeah, it's really neat

[00:08:19] **Dr Mike T Nelson:** process.

Yeah. I think your microphone sound a little bit different there, but we can still hear you. So I don't know if something happened on your computer or what. Let

[00:08:27] **Dr Brent Ruby:** me turn.

[00:08:27] **Dr Mike T Nelson:** Can, is that better? Yeah, it sounds a little better now for some

[00:08:30] **Dr Brent Ruby:** reason. Okay. I turned it up

[00:08:32] **Dr Mike T Nelson:** a little bit, but, oh, perfect. Yeah, it's, those meetings are always fascinating because just the level of questions they ask are just like, oh, it is a different level. Yeah,

[00:08:43] **Dr Brent Ruby:** absolutely. I've been to 'em, a lot of 'em over the years and it's always different, but I really

[00:08:49] **Dr Mike T Nelson:** enjoy 'em. Yeah. And so give us a rundown. I know your research, you started off looking at some glucose stuff for your PhD work and now you're looking at. Also the effects of extreme environments and these kind of crazy scenarios that humans find themselves in.

[00:09:08] **Dr Brent Ruby:** Yeah. The, sometimes they find them find themselves in there cuz we put them there. But

[00:09:13] **Dr Mike T Nelson:** we,

[00:09:15] **Dr Brent Ruby:** there's that. We over the years I think, I mean I've been at the University of Montana now for 29 years. Wow. And I know it's insane. So when I left the University of New Mexico, which is where I did my graduate studies the internet was just starting.

Which is funny cuz it makes me think, wow, the last real job I applied for was before the internet. Which is funny. But I yeah. When I finished at New Mexico, I had a strong interest in sex specific differences in metabolism and muscle fuel use. And I had explored some mechanistic mechanistic functions of estradiol and how that might affect the muscle and the liver during exercise and how it might shift some of the fuels that are used during exercise or work.

You could say muscle work, whatever. Sure. And so I brought some of that interest with me to Montana. And right out of the gate I knew it was gonna be a, an uphill battle because the facility, the facilities at the University of Montana were not awesome. Pretty dated. The lab was in an old locker room space.

So that, that was a bit of a struggle to get things rolling and there was really no equipment. But a couple years into my no, it was actually after the very first year I was here I was. Brian Sharkey, who's a longtime physiologist past president of A C S M. We decided to Brian decided that we were gonna take the train to the A C S M meeting in wherever it was, Minneapolis or something like that.

Oh man. Some, somewhere 30 some mile or 30 some hours into the east or to the Midwest. But while we were at the meeting, there was a call for research for a program that the Army was starting called the Defense Women's Health Research Program. And and they had a new investigator category and I thought, oh, that's fits me perfect.

You, you had to be within two years from finishing your terminal degree. And but they didn't give a lot of details. They let you fill in your own blank. And so I applied for that with the idea of continuing some of this tracer work with females and males. Sort of the sex comparison muscle fuel use.

But then I threw in the real kicker, which was what if we use some of those techniques with tracers in the operational world of the wildland firefighter? And

that's what I think got the attention of the reviewers. The reviewer comments were basically, I don't know if this is gonna work. It doesn't seem like it's had, had much experience with these kind of models.

And, but that's the license that you get for like these new investigator things. It's not that much money and they're willing to accept a higher risk. And so I did get the funding and then we it took a few years, but we pulled it all off. And that was back in, oh geez, mid nineties mid to late nineties when I started working with fire crews.

And that sort of been my. That's been one of my major passions is trying to work and serve that community with the research projects that we've done over the years. So yeah, but we do, we probably do as much of more work outside of the lab in these unique field settings compared to what we do in the controlled, wind up the researcher and turn 'em loose in the lab sort of

[00:12:53] **Dr Mike T Nelson:** environment.

And what are some things you've found over the years of doing this? Like one of the main questions I think about is, does the lab stuff always match the field work? And how do you go back and forth between those two? Because some people listening and they're like, I don't know, just do it in the field.

It's the same thing, but it's definitely not. And there's things you can do in the field, you can't do in the lab, things you can do in the lab, you can't do in the field.

[00:13:19] **Dr Brent Ruby:** Yeah. And I think a lot of researchers are freaked out by the idea of going out into the field. Because they, they have to make adjustments on the fly things.

Things don't always work. Most of the time they don't run, they, most of the time they don't work. Yeah. And they, things get broken and you can't control everything. And researchers are notoriously for wanting to control every little oh aspect of their studies so they can hone in on one single mechanism that as soon as you go out into the real world, the auxiliary stressors stamp down that one single factor that you've teased out in the lab is being such an important thing to consider.

But when you start layering on all the other stressors, could be the ambient temperature, the altitude, the radiant heat, the who knows what else. Then all of a sudden some of those. Tedious little factors fade into the background. And so

that's why going back and forth is really our strong suit because we develop some of the mechanistic stuff in the lab and then we take that into the field to see if it's, if you can transfer it over.

And also to determine if if the generalizability is gonna stick around. I gotta let my dog

[00:14:42] **Dr Mike T Nelson:** in real quick. Just Yeah, no worries. All good.

[00:14:47] **Dr Brent Ruby:** Okay buddy. I knew that was gonna happen cuz he

[00:14:51] **Dr Mike T Nelson:** Oh, that's alright. What kind of dog is it? I have two border. Oh, I bet they keep you busy.

[00:15:00] **Dr Brent Ruby:** They're the only dog I know that has a built-in fitness program that comes with

[00:15:05] **Dr Mike T Nelson:** them. Yeah.

Nice. Yeah. So you were saying about the lab and the experience in the field and trying to get variables to work out and the transfer between the two.

[00:15:20] **Dr Brent Ruby:** Yeah, the, generalizability at the end of the day is quite important for applied human research. So researchers are, it feels like I'm constantly trying to remind people that don't care to be reminded that fires don't get fought in the lab.

No one wins a gold medal in the lab. Stuff like that. And so we, you have to be able to make that, to bridge that gap continuously. And so we'll get ideas from our lab-based research that helps design some of our field questions and vice versa. So we'll be able to we'll develop maybe a mechanistic oriented question in the field and then take that back to the lab and.

Try to build more control into the design. But we have, we have chambers in the lab that we can go hot and cold. We can change the oh two concentration in the room to make it stimulate altitude. We have two hypobaric chambers that are relatively small. We can do resting studies in 'em all day long.

We can't really exercise 'em, they're not big enough. And then we have our mobile lab trailers that allow us to go out into the field and and off the grid sort of way. And they're solar have so solar capabilities so we can collect the samples and process the samples as necessary. And so we've done a lot of, been

to a lot of different events and a lot of different field settings with those trailers, which is they're massive asset.

[00:16:57] **Dr Mike T Nelson:** What are some of the surprising things that you found, especially with the trailers and being able to do kind of lab-based science in my little air quotes here, like in the field.

[00:17:07] **Dr Brent Ruby:** Yeah. I think we first started using the trailers for some of the work that we were doing with Wildland, and we would take those to different fire camps and we would be able to use those.

That's our staging area, so we can process all the data in there, take the samples, but on some of the fires we would deliver two stable isotope tracers and a, the technique is the doubly labeled water method for measuring energy expenditure. In sort of free range humans, and out in that field situation, we were able to do that with crews to identify what the overall energy demands of the job are.

And then from that data we can take it back and evaluate what are the current catering contract effects that these crews are doled out and are there necessary changes that we the data might advise. Or inform the agencies of course takes forever to change any sort of bureaucratic machine. But it has made a difference.

It's made a difference in the quality of the food that they've gotten, how that food is provided, how the provisions during the work shift are spelled out. So that, that was a really great use of the field work. We've also been to several ultra endurance events like Ironman and the Western States 100 and the Badwater Ultra Marathon.

And we just did a paper on a 24 hour pro mountain biker in a 24 hour race. And we've used that same tracer technique to develop a really good understanding of sort of the upper limits of human energy expenditure for periods of time from about 12 hours all the way out to five to six days. Wow.

And so we, we have a range of measured numbers from 12 hour races, 24 hour races, 48 hour races, 72 hours on the fire line, five days on the fire line. We did similar using the same exact technique, we studied a four-person team. Four man team during the race across America, which is, that's interesting, yeah. The cool part was, the cool part was all of our subjects were over 70 really? So that Yeah. And they threw down energy expenditure numbers that are more in line with, or they're the, basically the same sort of numbers that you would see in the

tour. Oh. So some obviously pro young riders they're throwing down similar numbers.

But yeah the muscle as it ages, it still retains some of, its, a lot of its awesome capabilities,

[00:19:58] **Dr Mike T Nelson:** but yeah. Years ago I was a volunteer staff person for a four person Race across America team probably god, 15 years ago now. And oh I got roped into it at the last minute because the head physiologist guy is he's Hey, you're looking at human performance and all this stuff.

You should go do this. Here's all the measures we're gonna do, and all this cool shit. And I didn't know much about it. I took 10 days off of work at that time and I'm like, great, this is fun. And I show up literally like the morning. We had one meeting beforehand. This was completely disorganized. I show up the day of the race that we're getting ready to go, and I asked the team manager guy, I said, Hey, where's this head physiology guy?

He is supposed to be here and tell me what to do and stuff. He's oh yeah, he can't make it. Oh no. What did, what do you mean he can't make it? He's oh, he was never planning to go. Did he tell you he was going? I'm like, oh no. I don't know if he did or not, but he highly inferred he was gonna be here.

Oh, geez. And so I'm just like whatever, how bad can it be? And so we, get all the way out to San Diego for people listening. At that time you started in San Diego, California, go all the way, literally across the entire United States and you ended up in Atlantic City. Yeah.

And it's one thing to do that as a ride, which is crazy, but it's another thing that this is a race. Like you are literally competing against teams from all over the world who show up to, to do this thing. So we get all the way out to San Diego and I have the first ship, following the cars and that kind of stuff.

And 36 hours into it, one of the riders comes off. And I said, hey, how's your hydration? He's I don't know. I haven't pissed in a long time. I'm like, oh, what's a long time? It's like several hours. And I said, when's the last time you went? What was the color of your urine? He's it was brown.

I'm like, brown. This is, oh no, this isn't good. He's yeah, I feel weird. So you give him a bunch of fluid, literally like five minutes after we give him fluid. I'm like, what are you doing? He's oh, I gotta piss again. I'm like, you just drank the fluid. He's yeah, my urine's clear now. I'm like, this is not a good sign.

Like you're not processing any fluid. So I take him off course to the emergency room. Oh 90 minutes off course. Get there. They put I don't know how many like bags of fluid in him. He is yeah, you got mild, heat stroke, or you know what's going on? Like for God's sake, don't exercise for three days.

He's oh yeah, whatever. And that was the first time I slept in 48 hours because, yeah, I missed my shift because I had to take him off course and I had to do a double shift when I started or missing a person. So I fall asleep in the waiting room and use a Kleenex box for my pillow, get this guy, get him back on course.

And he is I'm gonna keep riding. I'm like I wouldn't recommend this, but I'm not your doctor. Do whatever you're gonna do. And it was just bananas. And the second part that was even more crazy to me was, we're in like the middle of Nebraska or something like that. And this whole time you're thinking like we're talking about fuel usage and stuff.

And so I'm thinking in my head like, we got all these pre-packaged fuels and electrolytes and making sure to get 'em there, the right weights and the right proportions. And you realize like about halfway through the race that. In theory, those things are amazing, but you just do whatever you can do at that point.

Yeah. It's like one of the other riders, I'm like, Hey man, you haven't eaten in a while. He is if you show me that container of pre-packaged food again, I'm gonna throw it at you and I'm gonna vomit all over your shoes. I was like, yep. Oh. I'm like we can send someone to the store like we're halfway through the race.

What do you want? I like Fig newton's. Fig newton's. Okay, so this guy, I don't eat how many pounds of fig newton's for the next, couple days. And I'm like, if that's what it works. That's I guess what you'll do at that point.

[00:23:53] **Dr Brent Ruby:** And it, I, yeah we did not monitor what they ate.

We, as far as the, a lot of these studies, one of the hardest measures to capture is if you want to quantify somebody's dietary intake, that is a real struggle to do. Oh yeah. It's really hard unless you're using all pre-packaged meals and That's right. That's not gonna be sustainable either, but

[00:24:16] **Dr Mike T Nelson:** yeah. What did you find for energy expenditure?

You said it, I think people would be surprised at how much energy people go through doing something like that. Yeah.

[00:24:27] **Dr Brent Ruby:** The you can break it down. Obviously if the race is, or the event is shorter, you can tolerate a higher ha a higher load and you can tolerate being in negative energy balance just for that short window of time.

Maybe that's 12 to 36 hours. But beyond that it's really hard to maintain movement and accept the fate of what is negative energy balance so that threshold in humans. Depending on the situation is sometimes it's right around four times basal metabolic rate. And that's right where those riders Hubbard.

So for them and their body size, that amounted to about 6,000 kcals per day. Which is about what the average rider in the tour will expend. And they're hovering right at that four times b m r range. Now in races like Ironman, that's 12 hours, whatever you can tolerate much higher rates.

The Ironman costs anywhere from about eight to 9,000 calories, but that's in 12 hours. Oh yeah. Andrew, my little dog is whiny. Oh. So Ironman's about eight to 9,000. The Western states 100. Is the goal is to do that in 24 hours or less. That is the highest measured human energy expenditure in the literature.

And that average is right around 16,000. Whoa, that's insane. 24 hours. Yeah. In 24 hours. Wildland fire crews are gonna come in anywhere from about four to 6,000 calories per hour or per day for three to seven days at a time.

[00:26:15] **Dr Mike T Nelson:** And that's total daily energy expenditure. So the total number of calories are burning per day.

[00:26:20] **Dr Brent Ruby:** Correct. Yeah. Per 24 hour period.

[00:26:23] **Dr Mike T Nelson:** So what are your thoughts then of one over a multi-day period? Do you think that's like a hard cap? Do you think that can be raised or is that just a built-in physiologic kind of limit?

[00:26:38] **Dr Brent Ruby:** The limitation is obviously relates more to whether or not the gut can absorb and move that food through the system. Sure. And that's the rate limiting factor. You can train the gut to be better at absorbing monosaccharides. So with training of the gut through regulated eating during exercise and carbohydrate intake, you can change the, you can up-regulate the glucose and fructose transporters in the small intestine.

And so that might enable you to, instead of oxidizing, say 60 grams of carbohydrate an hour during exercise, you might be able to increase that to 90, sometimes as high as 120 grams an hour of that, that means if you consume 120 grams an hour, you might, the muscle is gonna be able to take advantage of that.

Cause you can absorb it better. So those. When those receptors are upregulated through the right kind of eat training or food training then it helps you preserve, obviously the onboard fuels for a little bit longer, but like events like Ironman and Western states, those are not, that's not normal human behavior.

No. Even for an early human that's trying to hunt down in their food and survive that way, there's no way an early human would ever have navigated towards a giant task like that because they would've died. Cuz there's not enough. It's not like access to unlimited food and water is available in those, in an early human environment.

We've. Artificially scripted these ridiculous races, and somehow the human has these underlying capabilities to take in monstrous amounts of food and to do the process or to do the event. But Ironman you're lucky to be able to consume 30, 35% of what you expend. You just willingly dig your own grave as far as energy imbalance.

And you do that temporarily after the race is over, you pound a whole bunch of food and the ne the next day you feel good.

[00:29:11] **Dr Mike T Nelson:** And then for listeners, the reason some of these races, cuz people might be thinking, they're like hey, wait a minute Lean athletes have a fair amount of body fat on 'em.

Yeah. Why can't they just use body fat? And I'm assuming it's the percentage of the intensity of work that they're trying to accomplish. Correct.

[00:29:28] **Dr Brent Ruby:** Yeah. I mean they, they're, it's hard to measure that measure total fat use in a race like that. Yeah. But yeah, you can, with some calculations, you could make some pretty fair assumptions that indeed there has been some significant mobilization of adipose or free fatty acids from the fat tissue.

And then of course the amount of fat that is intramuscular, that's gonna be used up. But yeah, as soon as you up-regulate the intensity, then sometimes fat can't be used as profoundly. And so those exogenous sources of carbohydrate fuel become increasingly important.

[00:30:13] **Dr Mike T Nelson:** Yeah, and I think there was, I can't remember the author, I believe there was a study on pretty high level, like half marathon runners, and I think they blocked the use of fat and found that their times like didn't really drop off hardly at all.

Which kind of lead you to believe that they're using almost entirely carbohydrates at that point. Yeah.

[00:30:33] **Dr Brent Ruby:** Oh yeah. The elite athletes, the ones that are,

[00:30:35] **Dr Mike T Nelson:** yeah, they were high ranking. They weren't just like people off the street.

[00:30:39] **Dr Brent Ruby:** Yep. That's, and you look at some of the elite marathon racers that are trying to knock on that two hour door their fuel use is enormously high in carbohydrate because that's what helps 'em go that fast.

The, if they wanna go slow, sure they become a fat user, but it's more fun to run fast.

[00:31:02] **Dr Mike T Nelson:** Yeah, and I think, wasn't that, I think Nike for the Breaking two reported that Kipchoge was using like 120 grams per hour, I think is what I was rumored to hear at one point.

[00:31:13] **Dr Brent Ruby:** That wouldn't surprise me. Yeah.

Especially when they've helped him dial in his a really unique combination or ratio of glucose and fructose mon monosaccharides. That when you do that in combination you're more likely to saturate all the receptors in the small intestine, but by saturating them, taking advantage of both monosaccharides and delivering both of those at the same time is, that's a powerhouse combination.

[00:31:45] **Dr Mike T Nelson:** Yeah. So for listeners, you've got different types of, Receptors that can pull different types of carbohydrates across. So instead of just bamboozling and just oversaturating one, you're trying to split it out over a couple so you can get the literally more fuel like out of your gut and potentially use it at that point.

Yep. Yeah. Very cool. What have you found of the limits of using like the doubly labeled water? Because I've had this theory for quite a while that I've heard rumors that there may be a consumer grade version because you think of I have a Garmin watch and Fitbits and everything.

People seem to be obsessed now with energy output. But the devices we have so far are maybe at best crude guess, no one's even gonna be wandering around with even a portable metabolic heart to do a lot of work. That's just a pain in the butt and limitations on that, especially in extreme environments.

What are your thoughts about the accuracy of it, and if it was commercially available, do you think it would be useful to general population or is it so much in the noise that it, useful for that would be maybe not as great? Yeah,

[00:32:54] **Dr Brent Ruby:** that's a good point. I, when I'm talking to several firefighters just recently they were asking about whether the Garmin watch would, if they recorded their heart rate throughout the whole day and their movement patterns with the Garmin watch, and then sent that to Strava and let the magic algorithms of the world take over.

They wanted to know if those were accurate energy expenditure estimates. And I said, no, they're absolutely not. But a Garmin watch wants, it's gonna work awesome for telling you what your energy expenditure is while you are running. Sure. That is the easiest form of activity to model because the mechanical efficiency of even not a great runner is predictable.

And so if you know the speed, you know the grade and it's a flat and it's a, and it's a smooth course, it's not, you are not running through trails or rocks or over logs or whatever, then you can use heart rate and you can use the GPS data you don't even need heart rate. You can use the GPS data to estimate the VO_2 quite accurately for running.

That's and if you have an integrated power meter on a bicycle, Then you can quite accurately measure VO_2 and therefore energy expenditure. But that's not applicable to an, a human that's not running on a smooth surface for 24 hours. They're you're doing other things. And so that's when the wearables start to fall apart is in their ability to add up all the different tasks that you do during the day.

You walk to the grocery store, you ride your bike for an hour, training you, whatever you rake leaves in your backyard. All those things add up to dictating what the total energy demand is or the total energy expenditure is. And no wearable can accurately do that. So the focus has been historically on let's just measure.

All the different movements that humans decide to do and build this giant compendium of physical activity. And then people can go to that and they can

look up, okay, rake leaves 20 minutes hard. Okay, that's this many calories. Okay cook dinner for an hour. That's this many calories. And they try to add it all up and it's it doesn't really, you don't really need to do that.

I don't see why there would be a rationale for doing that. And then on the flip side, people have become absolutely obsessed with measuring the oxygen consumption Oh yeah. Of a, as many different fitness oriented or movement or exercise oriented tasks. And that's fascinating for a while.

But then it's, I don't really care for portable metabolic systems. We have one, we have to use it for certain things, but. It's quite limited in what it can tell you. And we

[00:36:05] **Dr Mike T Nelson:** finicky little bastards too. Yeah,

[00:36:08] **Dr Brent Ruby:** no doubt. And they're expensive. And as soon as you walk outside of the lab, it's like there's a million demons out there that wanna break it.

Yeah. Because the subject trips or they fall in the water or whatever, and then it's over. We did use one, we used one in Ironman years ago to build just linear fit models of running speed and the VO two and the VCO two. So we could then estimate the energy expenditure of the difference, the dry land segments the cycling and the running.

And we compared that to doubly label water and did Oh, interesting. We did get a very good agreement. Overall for the window of time, that was the race. But that's just because the whole time you're either swimming, riding a bike and or running or, yeah sometimes not running.

Maybe you're walking or jogging or whatever. But if I have to ride a bike anytime soon on the big island, it will be too soon. I don't wanna ride a bike on that island ever again.

[00:37:17] **Dr Mike T Nelson:** I've only seen videos of it and I've helped just a couple people. Only two people who've actually done the one in Kona.

Yeah. Some other smaller races. And man, the handful of times I've watched on tv, it just looks

[00:37:29] **Dr Brent Ruby:** horrible. It's not a, it's not that enjoyable. I've done it twice and Oh yeah, the first time we. First time I did it, we took muscle

samples before and after the race from my leg to look at changes in muscle glycogen.

And that was done in parallel with the tracers to look at the energy demands and stuff. And so that was our first attempt at using this doubly label water methodology for shorter windows of time, which it's really not, it hasn't, wasn't really intended to be used for these short measurement periods, but because of how much water is turned over in that period of time, it enables the calculation which, which would otherwise take days. Yeah it is been a slick set. It's been a, it's been a slick way to to measure human energy expenditure in that 12 to 24 hour window. And when

[00:38:28] **Dr Mike T Nelson:** you were doing the biopsies, what did you find with glycogen changes in the second part to that question is from what I've read, and you can correct me if I'm wrong, you can probably only deplete muscle glycogen to maybe 30, 40 ish percent.

You can't drive it to like net zero. And why do you think there's a buffer zone on that, if that's true?

[00:38:50] **Dr Brent Ruby:** Probably to keep you from dying, but Yeah. The lower, the lowest numbers we have gotten to, certainly glycogens been, biopsies have been around for long time. Yeah. And it's been a lot of things known about glycogen use and how to put it back in the muscle effectively, how to take it out of the muscle painfully with interval.

Sort of excruciating lab trials, which we've done over and over again. We have a 90 minute protocol that's guaranteed to pull almost all of it out of the leg.

[00:39:24] **Dr Mike T Nelson:** I'm assuming that 90 minute protocol is not zone two.

[00:39:27] **Dr Brent Ruby:** No. It's got lots of intervals. It's got a nice little warmup, teaser and then lots of hardy intervals to just zap the legs.

But it's a real nice systematic way to drive it down. And then once it's down there, then you can do whatever it is you're interested in. If it's a recovery study or whatever. And we've done loads of those. But in, in an outdoor sort of free range event, not in the lab it's different and it's very different when you're eating during the, that situation.

Sure. For a long time it was thought that. Because these were only lab studies over and over these well-controlled lab studies that there was this thought that if you eat carbohydrate during a training ride or during exercise, it will not slow down the use of muscle glycogen.

Yeah. And we still

[00:40:19] **Dr Mike T Nelson:** hear that's still around,

[00:40:21] **Dr Brent Ruby:** which is true if it's a 90 minute lab trial. But when you enter the real world of competition for 12 hours or 24 hours or a day on the fire line, you can absolutely slow down muscle glycogen use. If you feed correctly, it, it becomes a surrogate source of muscle fuel.

It's just as if you strap on the food bag and you can save glycogen in the muscle for later on when you may not have access to foods. We have demonstrated that in the lab, but the lab trial was 10 hours long. Oof. And that preservation of muscle glycogen under 10 painful hours in the lab that response is the same in men as it is in women.

[00:41:15] **Dr Mike T Nelson:** Oh, interesting. Yeah. And is that because you're not necessarily replenishing muscle glycogen, you're actually training the body to pull more out as blood glucose as it shows up in the blood? Or are you replenishing some and using some off the topic glycogen so that the level doesn't go down?

Or kind of a combination of both?

[00:41:37] **Dr Brent Ruby:** A combination of both. You start the exercise. And you're not eating right away. So depending on the intensity you're pulling from the glycogen that you have in the muscles that you've sorted in, and the use of muscle glycogen is very specific to whatever the movement pattern is.

So we love to use cycling because the big fastest lateralis is a big mover. And that's a nice big giant target to stick your needle into. So we, yeah the that's why a lot of the cycling models work quite well for that. But yeah, you can slow down the use of the muscle source by delivering the oral source.

And there's been some incredibly well done studies in the lab where you can use multiple tracers. To identify where that what sources of carbohydrate are being oxidized by the muscle. Is it something that showed up from the liver that showed up via the blood as blood glucose, but it started in the liver?

Is it carbohydrate that started in the muscle as muscle glycogen or has it come from out of body? Has this has it come from something that you've consumed? So there's been some fantastic work by Oscars Youn Drop and some of the other folks that have just been awesomely poetic with the use of these different tracers and different techniques.

[00:43:11] **Dr Mike T Nelson:** Yeah. So what have they generally found with that? Like you, it sounds like you can, during higher intensity, long duration, offset some of that by just the consumption of more, exogenous or carbohydrates from outside the body.

[00:43:23] **Dr Brent Ruby:** Yep. Absolutely. Absolutely. And they'll take breath samples after giving a tracer orally, and the tracer incorporates itself into the CO₂ that's expired.

The label carbon associates with the carbon that's in the CO₂ that's expired. And so you can look at the ratio of unlabeled to labeled CO₂ and calculate the calculate. How much of it's usually expressed as a percentage of the total. Sure. So X percent of the total carbohydrate oxidized comes from this exogenous source.

X percent of the total comes from muscle. So you can break it down that way, which is a slick way to do it. But yeah, we've and across the sexes it seems as if. There, those variabilities don't shift around that much. They're pretty similar across the sexes. The one thing that we've noticed in some of our studies years ago with females is that when the reproductive hormones move around across ovulation, maybe it's pre ovulation in post or early follicular and mid ludial phase, when the hormone levels are what they are in a normal in a female that's not on any sort of exogenous hormone or birth control that would regulate, would modify those the natural effects of estradiol in particular.

It doesn't really change how much fat or carbohydrate might be used by the muscle at any one time. What it seems to change, and it's very subtle. Where the carbohydrate that is used comes from. It might subtly alter the rate that the liver dumps glucose into the blood. It might subtly alter the relative contribution from muscle carbohydrate or glycogen versus what comes from the blood.

But, I don't know about the exogenous question. Is still unanswered as if, from what I know, but that's all fine and awesome to understand some of these mechanistic sex specific responses as they relate to some of these hormones. But then as soon as you step outside of the lab, those really subtle factors that

might be that might be explained by different levels of estrogen, other factors outside of the lab and other stressors.

Now all of a sudden, those are the o overlying the body's being bombarded with those other stressors and the subtle effects of the hormones fade into the distance or into the background. Yeah. So that's why I really love, I'm a big fan of mechanistic lab studies, but you can't, you're not gonna hang your gold medal on that, or you're not gonna hang, you're not gonna hang your hat on that.

As soon as you step outside the lab, all bets are off. And so you have to toggle back and forth to most comprehensively get that science to the athlete or the coach or the clinician or whatever. You

[00:46:38] **Dr Mike T Nelson:** have to have both. Yeah. It seems like there's a little bit of trend in fitness now for different programs for women to do different types of training during different periods of their cycle and.

This has been around for a while. I think when the Stu Fields grad students just published a study on this. Yeah. That didn't show a any effect and Right. I tried this four or five years ago, cuz most of my clients are actually female. And I didn't notice, again, anecdotal, I didn't notice any difference.

I know had a fair amount of high level coaches, a lot of 'em who train all female teams at the Olympic level. I don't know any of 'em that have found it useful. But then that's not to say that there's not differences, like you were saying. There's clearly differences. There's different in hormonal outputs, they definitely do have effects, but I haven't found anyone who's so dialed in down to the NA's as that's the factor that mattered the most.

You know what I mean? Yeah. That's, I think sometimes people forget.

[00:47:35] **Dr Brent Ruby:** Yeah. That's a good way to think about it. It's easy to get, it's really easy to get enamored with. One factor or another that could be the metabolic effects of estrogen. That could be, oh, lots of stuff becoming overly enamored with certain products that are gonna guarantee muscle recovery better than others.

And I don't really like how the field of sport nutrition has dictated the behavior of the athlete. It's almost as if the field has tried to make eating more complex than it needs to be. And that, that, that confuses the shit out of the athlete. And it's almost as if that is the intent.

That's like, why is the intent to make it so confusing? Is that so that they have to work? A sport nutritionist to accomplish a daunting task of deciding what to eat. It shouldn't be that way. And I, years ago I got very frustrated with that and we decided to do a muscle recovery study, which we've done loads of.

And some of the early muscle recovery studies we did, were more traditional with but we shifted our focus towards seeing how what would happen to regulated muscle glycogen recovery if we changed the environment that the human or the muscle recovered in. And it's like everybody wants to talk about X number of grams per kilogram body weight per time interval of this and give the athlete these complicated formulas.

And it's okay, most of the time muscle recovery doesn't happen in an air conditioned. Clean space. Yeah. It's different. It's out in the real world where it's still sunny, it's hot, it's cold, it's whatever. And so we did all combinations of that. Hot muscle, hot body, cold body, cold muscle and looked at how muscle glycogen was put back into the leg with the same dietary strategy over and over again.

And the bottom line, it seems like from a lot of that research it's not well quoted, it's not well studied in the muscle recovery literature because it's not the primary I guess we basically showed that the environment that the body and the muscle recovers in is probably more important than dialing in the, a precise gram per kilogram dose.

You can make a lot of mistakes on your dosing. And still create ideal or near optimal muscle glycogen recovery. But if the temperature is not right, if the leg is too cold or the body's too hot, it'll slow things down and that doesn't get discussed.

[00:50:32] **Dr Mike T Nelson:** So someone really wants to push recovery and let's say they're doing some type of sport that's outside in a hot environment, then I assume the assumption would be you'd want to get back to thermo neutral.

You want to get back to a cooler environment as part of the recovery process, and vice versa. If you're in a cold environment, get back to some more thermal neutral environment, then

[00:50:56] **Dr Brent Ruby:** it's way more comfortable to recover if you've drained your glycogen and the heat, absolutely. Get in, get into an air conditioned environment and eat away in that environment.

In the cold. The cold doesn't the overall cold environment doesn't seem to slow down the restoration of muscle glycogen, but it would be un it's, those are very uncomfortable studies, not fun objects. Were very uncomfortable Yeah. During that four hour window of time. But if you put cold packs on the actual muscle, then that will slow down.

Glycogen recovery. If you would put warm packs on the muscle to keep the muscle nice and warm, it enhances muscle glycogen. So maybe the best the most unusual, most effective, maybe you exercised in the heat, you depleted your glycogen. Okay, now bring yourself into the air conditioned environment.

Eat a lot and keep your legs warm.

[00:52:00] **Dr Mike T Nelson:** Interesting. Huh? Hey, maybe you got some new devices coming

[00:52:04] **Dr Brent Ruby:** there for me. Yeah. Fuck yeah. We have used the devices that have become popular that are the leg pants, the squeeze pants. Yeah. The normal tech. And they don't do anything as far as changed glycogen recovery at all.

And as an athlete, as a, for, as a recovering Ironman I would, any normal person would probably rather have a human rub their legs than a robot. So I think the, it's, the money's better spent by paying a human to rub your legs instead of the pants or the leg sleeves.

[00:52:40] **Dr Mike T Nelson:** Yeah. I did not make a lot of friends in the recovery field a few years ago when I was asking for the studies to compare those types of pants to just walking.

And people got super mad at me. And the, oh, the only. Useful time, I think I came up with using them is, some pro teams will travel from the US to Europe to compete. Okay. Yeah. You wanna wear 'em on the plane where you just can't get up and move around that much. Cool. All right. That I buy that might be useful, to have all your guys come into a facility and wear 'em when you could easily walk outside in nature and take a hike.

Like just go outside and walk. And I get it. If you're in the middle of nowhere, you're an extreme environment. Yeah. Maybe you can't do it, maybe, yeah. But then everyone's oh, but look at this study, look at that. I'm like, but they compare it to sitting doing nothing. Compare it to some just basic movement, just walk, but

[00:53:29] **Dr Brent Ruby:** yeah, I think in the post-op environment, that's where they, those devices are. Yeah. That's where they come from. Yeah. But you, when you've got normal blood flow in a healthy human, you're not gonna all of a sudden ramp up the blood flow tenfold and no. Create. Awesome. It doesn't work that way.

And I the other argument that is so needs to die is, oh it helps remove lactate

[00:53:55] **Dr Mike T Nelson:** from the, oh no, not the flush L of lactate. Yeah.

[00:53:58] **Dr Brent Ruby:** It's so any movement does that and what's so bad about lactate anyways? Nothing. So that's not a Yeah, and we did we showed the muscle lactate and the blood lactate was unaffected by those pants.

And a lactate is so transient in the body anyways. It's not gonna linger and it causes no pain anyways. It's just a fantastic fuel source for the right kind of muscle. So stupid. But those kind of things drive me insane on when I seen different products that claim to be, oh, this is, we've We have made recovery great.

Again, use our product. It is undeniably the best and it's like recover from what? What are you trying to recover? Muscle glycogen. Because when I think of muscle recovery, I think of muscle glycogen as an skinny endurance glycogen user for decades. That was what I needed recovery from is depleted muscle glycogen, but muscle damage is different kind of recovery, maybe different dietary needs, but normal humans navigate pretty well to the right kind of foods after their, after they tax themselves.

So yeah, I a

[00:55:13] **Dr Mike T Nelson:** formula institution that I'm no longer at anymore, so I won't say their name. But anyway, I got in trouble because I was teaching half massage therapy. Students were taking my exercise physics class and they had written an essay and said that, I said, Hey, what is it? Why are, what are some of the benefits of massage?

And a couple of 'em are like we're flushing the lactic asset out of the muscles of these athletes. Yeah. And I said, okay, cool. Show me the data. Go find me data. Yeah. That show, and they came up with one line from some obscure website somewhere. No, like peer reviewed, published, yeah.

Literature that shows that this is a thing and they couldn't find it. No. And so instead of questioning it, they complained to the dean who then calls me into her office who's what are you doing with these students? And I'm like, Hey man, I'm just asking them like you would anything else?

Where's the data for this practice? And that, yeah. As I know there is no data and I said I if I was a massage therapist and I went to a high level team in the 21st century and said, I'm gonna help do hands-on work, your lead athletes to get lactic acid out of their muscles, like you're probably not getting that job right.

You might have the best hands in the world too, is the unfortunate part. But even At that level. That was one of the things that was still being preached like, four years ago is, and yeah, it's crazy.

[00:56:32] **Dr Brent Ruby:** Yeah. That though, it's hard to make those things die and some of those myths and issues just live on Facebook and whatever other social media source or crap that circulates and it's it's mind numbing.

In the world of wild and fire, those myths circulate over and over. And the persistent people's perception of the job is not what the job actually is. And so when they say, oh, you need these electrolyte tablets, it's really? When firefighters consume an average of 6,000 milligrams of sodium in a.

Do you really need to consume more? They do have enormous water budgets, like seven to 10 liters a day. And so yeah you're gonna need extra electrolyte, but the diet paves the way for that. Yeah. I don't get me started. Ah, that's

[00:57:25] **Dr Mike T Nelson:** all right. What do you think about lactate as a supplement?

[00:57:30] **Dr Brent Ruby:** It's there are a few drink manufacturers that have used lactate in the beret in the powdered drink mix. And it, it's just an alternative fuel source, not for every muscle, but if you're, if the muscle is well gifted in mitochondrial content, then it can be used as a substrate.

And that's been shown over and over some old studies. Have demonstrated that. Yeah that's nothing new,

[00:57:59] **Dr Mike T Nelson:** but yeah. But every time I mention it to people, a non-research area, they're like, what year? I have this thing for seven years now. I've been trying to get lactate as a supplement.

And for the first three years I was only going to people I knew in the sports supplement industry and sign NDAs and all this stuff. And they all told me I was just completely outta my tree and I'm an idiot. But then I would talk to, researchers like yourself who had done a lot of the work and George Brooks's work and yeah, they're all like yeah.

It, it should at least be tested. It's a handful of Yeah. Studies on him. It's four years ago I just gave up and I'm just like, Hey, what do you, people should do this. Someone let me know if it works or not. So

[00:58:38] **Dr Brent Ruby:** yeah. I think the one drink mix that comes to mind just popped back into my brain with cytomax.

Yeah,

[00:58:46] **Dr Mike T Nelson:** that was Jill patent that Brooks had.

[00:58:48] **Dr Brent Ruby:** It had poly lactate in it. Yep. As a

[00:58:50] **Dr Mike T Nelson:** substrate. Yeah. Yeah. And I, as far as I can tell, it's off patent now. And you can buy calcium lactate, which we've played around another buddy of mine, a different lab. And unfortunately the data right now is, it's anecdotal by the data, but it's pretty mixed.

But it seems to be, digestion is the issue cuz you've gotta attach it to a calcium ion and you can only have so many calciums floating around in your gut before it gets pissed off of.

[00:59:20] **Dr Brent Ruby:** Yeah. I don't, I'm not, I've not tried it. I've not tried, we've not tried any studies like that.

[00:59:25] **Dr Mike T Nelson:** Last couple of questions we wrap up. What are your thoughts now about all the craze with saunas and cold water immersion and people going a little bit nutty with temperature?

[00:59:37] **Dr Brent Ruby:** I, we've, the only studies we've done with temperature measures, we've done quite a number of 'em. One of my colleagues has looked at gene response, how recovering in a cold environment might upregulate certain genes that are mitochondrial oriented genes. But that doesn't mean that athletes are gonna all of a sudden do that.

And this was like a four hour gibbering on a bed. Your metabolic rate was four times what it is at rest, or the, sorry. The seemingly the resting VO two was up near 20 mls per kg. Wow. Because they were shivering so fast. They're

[01:00:20] **Dr Mike T Nelson:** shivering though. Yeah, that's,

[01:00:22] **Dr Brent Ruby:** and but if it does cold water immersion work, I've had enormous success with that in years and years ago as a college track athlete running indoor on a beater of a track and just thrash the legs and then getting into the pool, the whirlpool, just up to your knees and and ice the lower legs. I don't know if it was doing any good, but it sure was fun to sit in there with four other dudes and talk about how fast you ran that day. And so I felt better about myself. Yeah. Cause we were together. It was a social event and I don't know if it works. People, if it makes people feel better and Yeah.

Who am I to say don't do it? But there are it's when these kind of modalities prey on the naive mindset of some of these athletes that want to try. Anything they wanna try the next thing. And so it's I've got money, I'll buy that. And there's companies that'll crop up and say, here we go. You could just go to the local ranch and feed store and buy a tank and fill it with ice.

Or you could buy our fancy system. And so just stuff like, that's never gonna go away. It's gonna come and go and come and go and come and go and the recovery in cold environments or cold plunges, yeah, I'm not gonna be the one to do the research on that kind of stuff. No. But I guess never say never.

[01:01:56] **Dr Mike T Nelson:** Yeah. Yeah. I'm working to get a buddy of mine who he helped with some of the early military research on that and. Tell me stories about, getting the metabolic card in the boat and having the PI go out there and test it. And you've got, the rectal thermometers and all this stuff.

Oh yeah. And you read some of these early studies that were done, a lot of times decades ago. You're like, oh my God, what a pain in the hats to do that kind of research.

[01:02:21] **Dr Brent Ruby:** Yeah. I wouldn't wanna do cold weather. Just any sort of big tank of water is hard to manage. Yeah.

[01:02:29] **Dr Mike T Nelson:** Yeah. Cool. Any other departing thoughts in terms of like, all the stuff you've done and things that might be surprising to people that they may not be familiar with, or things that still piss you off and myths that need to die?

[01:02:45] **Dr Brent Ruby:** Oh, there's probably a laundry list of that, but I don't know. I think my biggest, my, one of my biggest philosophies with the research that we've done is that I always try to remember who we're doing it for. And why we're doing it. We're not doing it to make soccer players faster. We're not doing it to maybe there's some unintended result that comes out that'll affect athletics in some way.

Most of our research serves the tactical operators. I don't really care to call 'em tactical athletes. I don't like that terminology because their field of work is not a play field and I don't like to trivialize it in any way, shape, or form like that. But that's, yeah. My take on it, whatever.

There's plenty of people out there that stay tactical, athlete, whatever. I will just not say that. I don't call firefighters that. And I think I've become enormously close with that fire community. And so to realize that the research that we do can change what happens. Maybe it. Four 30 or five o'clock in the afternoon when the shit hits the fan and the fire behavior goes off the rails if they're fed right, they're gonna make better decisions in that situation.

And so I really like that that aspect of the doing the research that we do. And I think I also really like playing with these different environments because the way a human and their muscle and whatever other system you wanna study, how that behaves in a controlled laboratory setting doesn't necessarily simulate or predict how an individual's gonna respond out in the real world of high altitude or cold or whatever.

So we, we build these different models that enable load stress or nutrient stress, or physical stress or environmental stress. And then we look at what the muscle does and how it responds, and it just gives a better picture. So I just love, I always love challenging the status quo in the field, whatever it is, but particularly in the realm of human energy expenditure and how to feed people better.

[01:05:00] **Dr Mike T Nelson:** Awesome. And I know you have a book out. Tell us about that. I have a coup. I have a couple. A couple, right?

[01:05:06] **Dr Brent Ruby:** Yeah. Yeah. When Covid happened before Covid I became concerned that my wheelhouse was not big enough in terms of how the research we were doing in fire was helping the firefighter.

I would talk to crews and crew members, some of which I'd known for 20 plus years, and they would s they would describe the working environment and the

job. And they would say, yeah, the physical work, the stress, the sleep issues, the, this, all the things those bear down on a person. But the things that shape their mindset, or really affect them negatively are the human factors of being away from loved ones, being away from their children or their families.

And then when they do come back, the difficulty re-engaging and dealing with that in the aftermath of the season, re aftermath of one assignment. And I'm not a firefighter. The only reason I've dealt with the stresses that I've dealt with on fires are different from what they've dealt with.

But at the same time, a lot of times when we were doing those studies, I was away from my family and my young children who are now long grown up. But that was a point of stress and I can only imagine how difficult that is for the firefighters. And so I was hiking on the mountain with my crazy border collies and I just started laughing, thinking I should write a children's book about a fire crew of dogs.

And of course, like so many things, I came home and I told Joe, my wife, I have this great idea. I think I'm gonna write a children's book. And so many other of my initial great ideas, her response is, why do you have to be like that? And so I, but I, and then I, so I started the planning and some of the initial writing and I really started enjoying it.

But of course, real work and everything else slows you down. And then when Covid slowed everything down and we weren't able to do a lot of things for a while I had. Time to play around with that. And so I wrote that book, so that book's called Rango and Banjo on the Fire Line. And it's a story of it's not a hotshot crew cuz they're dogs, so it's a hotdog crew, but a crew and a Missoula crew of firefighters that are all dogs and some of their adventures on the line, which, and I've gotten some sweet letters from kids and parents.

Oh. And just to say how it's helped them with this bridge to share their own stories on the line and may, I can't even imagine how fearful some of these kids might be when their folks go off or their grandparents are unled. Sure. So yeah. It's definitely not research, but it's filling a niche that maybe the research that we've done can't even come close to scratching.

So I've, I enjoy that part of it. Yeah. But

[01:08:14] **Dr Mike T Nelson:** Oh yeah we'll definitely link to it and I can read it a little bit cuz my wife and I wrote a book called Mr. Mole Goes to Sleep. Nice. And the idea was it's she wrote all the kind of Dr. Seko lyrics and then I

put some sleep tips in the middle. And similar, like our thought process was telling adults to sleep more and sleep better.

Huge physiologic payoff, but it's like pounding my head against a wall. Yeah. It's just, it's so hard. But we're like, kids will read a, or adults will read a book to their kids. So what if we write it like a kid's book, but it has all the information for adults and then we'll target the adults to read it to their kids and be like,

[01:08:53] **Dr Brent Ruby:** oh, yes.

That's awesome. That's awesome. I would encourage, not everybody has that creative interest. I remember telling colleagues that I was gonna do colleagues at the university and they'd like what are you thinking? Why are you wasting your time with that? And, but I, yeah, I really enjoyed it.

This is a great experience. I would totally do it again if I came up with a different story, but the fact that I was able to link it to decades of work with fire crews, that made it more meaningful.

[01:09:25] **Dr Mike T Nelson:** No, I think that's awesome. And it's a way of conveying all your knowledge to a new audience and a different method too, because, just a handful of studies I've done, I'm like, I'm sure four people have read my dissertation.

Maybe if that, so like at some point the older I get, the more I'm like, is that the best use of time? Because like you've put all the time and effort into it and you want, you wanna see the thing actually translate into, to action for more people too, not just impress. Academics who will probably never put it into use anyway sometimes.

[01:09:57] **Dr Brent Ruby:** Or tell you that you did it wrong. Oh yeah, that

[01:10:00] **Dr Mike T Nelson:** too. Yeah. That's great. Cool. So where can they find the book? I know it's on Amazon, correct?

[01:10:07] **Dr Brent Ruby:** It is, but my website, the Wrango and Banjo Rango spelled with a w like the jeans wrangler, but wrangoandbanjo.com. If you order it to the website, of course, then I send it to you personally.

I sign it Nice it to whatever you want, and yeah, it's just, and it's a, it's the, yeah that's my preferred. Amazon is not the friendliest to new authors. Yeah.

[01:10:34] **Dr Mike T Nelson:** And then do you, are you looking for any grad students or anyone there in your department or anyone else?

[01:10:40] **Dr Brent Ruby:** That's one. That's wonderful.

Yeah, with some of our studies coming up, we are very interested in new applicants. We would really like to secure a female doc student maybe a female master student because of some of the studies we have coming up are all sex difference specific. And we want that, we want more diversity in our lab team.

So yeah, if you know of any out there, shoot me an email. I'd love to chat with you. Our call. How could they contact you? My regular email, which is just brent.ruby@mso.umt.edu. It's easily you can find it and the university if you go to the university site, which I could send you my university link.

Which is, I would just like the university sponsored website or WebLink for me. It's got like Google Scholar profiles access to those papers. Oh, perfect. And then a whole bunch of links for some podcast work and some videos that we've done with different stories or we had a podcast for fire, a lot of fire centric topics.

And so those are all embedded in that site. So I'll email it's on the, it's actually on the tagline of my email, so you can Oh,

[01:11:58] **Dr Mike T Nelson:** okay. We'll grab it. Yeah. Perfect. Yeah, we'll definitely make sure to link up all of those. And yeah, thank you so much for your time today. I really appreciate it.

This is a very fun discussion and I thank you so much for all the great research you've done throughout the years. And it's nice. I can just ask you all my crazy questions and you're like, oh, we did study on this and that and

[01:12:16] **Dr Brent Ruby:** it's funny. Yeah. It's been a while. It's nice to chat with you again.

That's awesome.

[01:12:22] **Dr Mike T Nelson:** Yeah. Thank you so much. Appreciate it.

[01:12:30] **Dr Mike T Nelson:** Thank you so much for listening to the podcast today. Really appreciate it.

I'm recording this from beautiful Colorado. So we're out here for a wedding, which has been amazing. And huge thanks to Dr. Brent Ruby for all of his work over the decades, and especially for taking time out today and answering all my crazy questions about the extremes of physiology. He has some really great stuff.

I would highly recommend you check out all of his work, and if you want more information on how to improve body composition and performance, especially if you are a coach. To me I'm biased because my background is in engineering. You need a complete system in order to figure out how to do it, and if you know how to do that, it will save you tons of time.

So you can listen to my podcast with Dr. Jade, and we talked about systems and how they are crucial to understand the ins and outs of what to do on a daily basis. And to me it's great, especially now with the advent of the internet, you could actually literally buy somebody's system that they have put decades of time into.

So I first started looking at metabolic flexibility going back over 14 years ago now. I did my PhD on the topic was my part of my dissertation. That and heart rate variability. And I've condensed this down after working with clients for God, almost coming up on 20 ish years now. And you can buy the whole system and literally apply it to yourself and to all your clients.

And the great part is that it has a huge amount of leverage. So instead of trying to figure everything out on your own, my bias is buy somebody's system. Heck, even if you don't buy mine and apply it, get really good at that, and then you can move forward and start to iterate in advance. So check it out.

It's the Flex Diet Cert. Go to flexdiet.com. F L E X D I E T.com For all of the details, it opens a June 5th, 2023. You can get on the wait list now. I'll have some very cool bonus items that go out to you. If you're listening to this after it don't worry. You can still get on the wait list and we will notify you the very next time that it's open.

Same website. Go to flexdiet.com. Thank you so much for listening to the podcast. Huge. Thanks Dr. Brent Ruby, for all of his work over decades. Doing the great stuff he's been doing. I thank him for taking time out of his very busy

schedule to talk to all of us today. If you enjoyed this podcast, please leave us whatever stars in review you think is appropriate.

Even just a couple sentences really helps us out with all the algorithms to get it pushed up. Or if you find someone who you would enjoy this please forward it to me. Thank you so much, greatly appreciate it. I will talk to all of you next week.