Welcome to the Huberman Lab Podcast, where we discuss science and science-based tools for everyday life. I'm Andrew Huberman and I'm a professor of neurobiology and ophthalmology at Stanford School of Medicine. This podcast is separate from my teaching and research roles at Stanford. It is, however, part of my desire and effort to bring zero cost to consumer information about science and science-related tools to the general public. Today is the third episode in our series of episodes about physical and athletic skill performance and skill learning in general. And today we're going to talk about the science of tools for fat loss. Fat loss is something that interests a large number of people. Many people want to lose fat. Many people are athletes who need to lose fat. And in general, we know that having body fat percentages that are too high is unhealthy for us. And most people struggle to lose fat. We'll struggle to lose weight generally, but most people especially struggle to lose body fat or what we call adipose tissue. Now, this is a huge topic on the internet. There's a lot of controversy. Today we're going to talk about some things related to fat loss and that are powerful for fat loss that I'm guessing most of you have never heard about before. You may have heard about a few of them, but I'm guessing you haven't heard about all of them. This episode is going to be rich with science-based tools that are gleaned from a variety of aspects of the literature including the use of cold, including brown fat, including something called beige fat. We're going to talk about something called meat. We're going to talk about all sorts of aspects of fat loss that are governed by your nervous system. And this is, I think, an important gap that's missing in the discussion about fat loss. You can hear a lot of information out there about the role of things like insulin and various diets like ketogenic diets or vegan diets or Mediterranean diets. And there's some great stuff out there and there's some really terrible information out there and there's a lot of controversy. We did a number of episodes talking about the role of hormones on metabolism and the role of food on mood and well-being. So if you're interested in those topics, please check them out. I will touch a little bit on hormones today, things like insulin and leptin just a little bit. But today's episode is mainly going to be focused on how the nervous system neurons and some of the cells they collaborate with like glia and macrophages, how those encourage or can encourage accelerated fat loss because it turns out they can. Remember your nervous system which includes your brain and your spinal cord and all the connections that they make with the organs of the body, governs everything. It's the on switch and the off switch for your immune system. It's the on switch and the off switch. It turns out also for fat burning. And so the nervous system and the role of the brain and other neurons has been vastly overlooked in the discussion about losing fat. Now, I would be remiss and I'd probably come under a pretty considerable attack if I didn't just acknowledge upfront a core truth of metabolic science and also of neuroscience, frankly, which is that calories in versus calories out, meaning how many calories you ingest versus how many calories you burn. And so this is the fundamental and most important formula in this business of fat loss and weight management in general. There's simply no way around the fact that if you ingest far more calories than you burn, you're likely to gain weight and a good portion of that weight is likely to be at a post tissue fat. So it's true that if you ingest fewer calories than you burn, that you will lose weight and that a significant portion of that will come from body fat. What portion depends on the number of factors, but that simple formula is important. On a previous episode, I mentioned the complications with the statements of a calorie is a calorie. And indeed, there is evidence from, for instance, Robert Lustig, who's a pediatric endocrinologist at UC San Francisco. How highly processed foods change the way that we utilize food and can lead to higher incidences of obesity and other metabolic syndromes that go against the idea that a calorie is a calorie and that's it. So a calorie is a calorie as a unit of energy and we need to accept and acknowledge this calories in, meaning calories ingested versus calories burned formula. But the calories burned portion is strongly influenced by a number of things that you can control that can greatly accelerate or increase the amount of adipose tissue or the proportion of adipose tissue that you burn in response to exercise and food. So your hormones are important. Your thermogenic milieu, meaning how warm or how cold your body is, how cold you make it, how warm you make it, but also your level of metabolism, your levels of thyroid hormone, and something that's hardly ever discussed but is well supported by the scientific literature. How much innervation, meaning how much connectivity there is between your nervous system and fat. Today we're going to talk about the fact that your body fat of various kinds, and there are several kinds of body fat, are actually innervated by neurons, neurons connect to your body fat and can change the probability that that body fat will be burned or not. So your nervous system is the master controller of this process, and it plays a strong role in the calories out, the calories burned component. So as usual, we're going to discuss a little bit of science. I promise I won't go too deep into lipolysis and all sorts of things related to fat oxidation. We're going to break down that process into two important steps, and if you can understand those two important steps, then the rest of the tools will be very straightforward to understand and manage. And I do believe that today you will walk away with many new tools that you could incorporate into any kind of fat loss regimen that will greatly accelerate that process because it's grounded in quality peer reviewed science. Throughout the episode, I'm going to talk about some behavioral tools. In fact, I'll mostly talk about behavioral tools. I will also talk about compound supplements. Many of you are into supplements. Some of you aren't, and that's fine. For those of you that are into supplements, an important issue in a discussion about supplements for fat loss or otherwise is going to be the quality of those supplements and the accuracy about what's in those supplement bottles and tablets, etc. I usually mention this at the end of the podcast, but this podcast we've partnered with Thorn, THOR and E because Thorn, we believe, has the highest levels of stringency in terms of the quality of the compounds in their supplements and the amounts of those compounds. If you want to see the supplements I take, you can go to THORN.COM slash the letter U slash Huberman. You can see the supplements that I take that will also allow you to get 20% off any of those supplements or 20% off any of the other supplements that Thorn makes. Thorn has partnered with the Mayo Clinic and all the major sports teams, so there's a very strong basis for their stringency. Again, you don't need to use supplements. I'm certainly not encouraging anyone to use supplements if that's not your thing, but if you're going to use supplements, make sure that your supplement source is one of very high quality. With that said, I want to get started and talk about the various tools for fat loss and how neuroscience neurons control fat loss. Before I do that, I want to set the context correctly and extract some of the key takeaways from previous episodes because if your foundation of health and your foundation of hormones and your foundation of metabolism isn't right, it's going to be very hard to get the most out of any kind of exercise or fat loss protocol. In previous episodes, I talked all about the science and the details going into particular protocols. We don't have time to do that now and I want to get to the new material. However, there are a couple bins, a couple items that you should make sure you're getting correctly. And if you're not perfect about these, don't worry about it. Most people are not perfect about them. I'm certainly not perfect about them. But we should all be striving to get quality and sufficient sleep. I did four full episodes on sleep and how to get better at sleeping through things like light exposure, temperature, timing your sleep correctly for your so-called chronotype if you're a night owl or a morning person. That's the first four or I think five episodes of the Huberman lab podcast. Get your sleep right. Get your light exposure right. Avoid bright light in your eyes at times you want to be asleep and get bright light in your eyes at times you want to be awake. So get your sleep right. The other thing is essential fatty acids. I talked about this in the food and mood episode, but I also talked about it during the hormones episodes. We need fatty acids. They are vital to so many aspects of our health. You don't have to get them from supplements. You can if you want to, but you need to get them from your food. They are essential. There's a reason there's an E, the essential part there. Of the fatty acids, there are multiple kinds, but for the antidepressant effects or the levels of fatty acids that will promote good mood and also healthy metabolism and will start to shift the needle in the right direction on bloodborne cardiovascular factors. The key thing is to get the levels of EPA that you ingest above 1000 milligrams per day. So that doesn't mean just taking 1000 milligrams or more of say fish oil or krill oil or whatever your preferred sources. It means getting above 1000 milligrams of EPA, which may require that you ingest more essential fatty acids than just 1000 milligrams per day. That of course can be done through food sources, things like fatty fish or if you're not, if you're not into eating fish, you have quality meats that are grass rays can do that. There are other sources of essential fatty acids, of course, also from plant sources. So look those up online. It's really easy to find. But the research in the literature shows that you want to get above 1000 milligrams of EPA per day, because that's when you can best support your metabolism and position yourself for good fat loss. As well for people who have cravings issues, they crave sweets all the time. I talked about this in the gut brain episode and hormones and food that you have neurons in your gut that are craving their seeking essential fatty acids and their craving and seeking amino acids from your food. Now these are not supplements that they crave per se. They're craving those things because that's what your body needs and your brain needs. But those same neurons will respond to sugars. And so many people who are craving sugar can satisfy that sugar craving by giving the neurons, so to speak, what they actually want, which are amino acids and essential fatty acids. That includes EPA, but also things like glutamine and amino acid that can really reduce sugar cravings if you take a teaspoon of that or even a table spoon of that a few times a day. You have to ease into that a little bit because some people can get a little bit of GI distress from too much glutamine. But glutamine has also been shown to improve symptoms of leaky gut. It's a powerful amino acid and yes, you can also get it from food, things like cottage cheese or high in glutamine, et cetera. And then finally, you can't really position yourself to have a strong metabolism if your iodine levels aren't correct and your thyroid levels aren't correct. You can overdo iodine so you don't want to do that. A lot of table salt has iodine added to it, but some people need to add iodine by ingesting things like kelp, et cetera. But one of the best ways to support the thyroid system and metabolism in general is to make sure you're getting enough selenium, sometimes called selenium. Each day, simple way to do that is to ingest the highest concentration of selenium food that I'm aware of, which is Brazil nuts, one or two or three of those per day, you'll have more than enough selenium to meet the thyroid needs. You don't want your selenium to be too high. You don't want a diet too high in anything. So again, sleep, sufficient EPA's glutamine, if you have issues with leaky gut or sugar cravings can really help get your gut microbiome right. I may have missing that but get your gut microbiome right. That does not necessarily mean you need to ingest probiotics. You can if you want to, but you can also just simply ingest a serving or two of fermented foods per day. That can greatly assist to things like sour, crout kimchi, every culture has a different source or sources of fermented foods. Those can really help the gut microbiome. And then make sure that your thyroid hormone is supported through the ingestion of sufficient iodine not too much and sufficient selenium not too much. Sleep EPA, glutamine, fermented foods, iodine selenium. That sets the basis for how things like exercise cold and some of the compounds and other things that we're going to talk about today that are I'm guessing truly going to be truly new to many of you that can really increase the burn factor in the equation of calories in versus calories burned. Okay. So on the one hand, we have this reality of calories in versus calories burned. However, I would also be remiss if I didn't mention an incredible study that was done by my colleague, Alia Crom at Stanford. She's a faculty member, a professor in the psychology department. Looking at how belief effects just thinking can impact the effects of things like exercise on weight loss. These are just incredible results. What they did was they took subjects who were hotel service people that would clean the hotels and come in and change the linens and so forth. Divide them into two groups. One group, they were told moving around and doing your duties for your job, meet the standards for US guidelines for activity and movement, etc. And a basic lecture about how movement is good for you, etc. But mostly just that their daily activities met the standards for the US. The other group, however, was given a bunch of information about how movement and their daily routine was very good for cardiovascular health. It could be good for weight loss, etc. And then they tracked these subjects over a period of many weeks. The take home message from the study was that simply being told that movement is good for you can lead to weight loss, etc. Lead to significantly more body fat loss, waste to hip ratio changes in the direction that most people would want, essentially a slimming down, if you will. And all sorts of other positive effects on things like cardiovascular health, simply by the knowledge that movement and exercise can help various health markers. So this is remarkable and it speaks to the power of the nervous system and the power of belief in governing aspects of our body and our physiology that one would otherwise think we're outside our conscious control. Now of course, any of you that think scientifically, which I imagine if you watch this podcast or listen to this podcast is all of you by now probably thinking, well, maybe they just moved around more or maybe they stood up and sat down more. Maybe they did something else that was different. And indeed there's a strong possibility that they did things differently than the other group. But the mere knowledge that exercises good for you, that movement is good for you, shifted their behavior and their physiology in the direction of enhanced weight loss, fat loss, etc. So how we think about a given set of activities affects how we perform those activities and how we think about and perform those activities has a real effect on our physiology. So somewhere between the hard and fast rule that governs fat loss and weight loss, which is if you ingest more calories than you burn, you'll either maintain or gain weight, typically you'll gain weight, although not always. If you ingest about as many calories as you burn, you maintain weight, typically. And if you ingest fewer calories than you burn, typically you'll lose weight. That's the kind of rule of fat loss. And yet we also have these belief effects which show, and this has been replicated again and again, that how we think about a process, whether or not we think it's beneficial can change our physiology in ways that can be beneficial to us. Somewhere in between those two extremes of hard-cormon metabolic science and belief effects, why a bunch of protocols that are grounded in quality peer-reviewed science and in physiology, that you can leverage to increase the rates of fat loss. And so that's what we're going to talk about today. I love this topic, and it's not that I'm so obsessed with fat loss, but rather the first project I ever worked on in science was thermogenesis and fat loss. I joined a laboratory as an undergraduate, and the guy I worked for loved to explore new compounds and how they impacted thermogenesis. And so we looked at how things like MDMA, ecstasy, how anti-psychotics, antidepressants, various weight loss drugs that were on the market, how those impacted body temperature and fat loss and metabolism. And we just had so much fun doing it. So if you detect a smile on my face, that's what that's about. And I also learned a lot, and I also came to really appreciate that this tissue of our bodies, at a post tissue and fat. We think of as just this unfortunate thing, this like we're told it's a core energy source if we ever entered a famine and that's all true, etc. We come to realize that these cells in our body, they are there as fuel for the furnace of our body, which is our metabolism. And there's a third player, and that's where it really gets interesting that the nervous system, neurons, has the opportunity to turn up the intensity of that furnace. It has the opportunity to increase the amount of heat that we produce and therefore the amount of energy that we burn. And I was also really intrigued by something which is that growing up, I think we all know people who can eat a ton and never seem to gain any body fat. Or people who seem to eat very little and seem to gain body fat very easily. And I was always intrigued by that. And it turns out there are a number of different factors that relate to that. But the nervous system is the one that we can really control, both through behaviors and what we eat, but also in terms of this thing that we call thermogenesis. There was one particular story I want to relate to you that does not suggest any protocol. In fact, I'm going to discourage you from following this protocol. Please do not try the compound that I'm about to describe. One of the favorite things that we like to do in that lab was to find rare compounds and test them. And at the time I was reading about thermogenesis and I learned about a compound that was actually discovered in the armory factories of World War II. And it was discovered because women in particular who were working in these factories would take a brush and dip it in a compound or a paint rather. And they would then paint the numbers with a stencil onto things like bombs and ammunition of various kinds. And they were losing weight like crazy. And it turns out that occasion they'd lick the brush and then they would go back just to a sharper point on the brush. And then they would paint onto these various bullets and missiles and so forth bombs and so forth. And they started shedding all their body fat. And many of them lost a lot of weight, a significant portion of their weight, without changing anything else that they were doing, what they were eating, etc. Turned out that that compound is something called dinitrophenol, DNP. And over the years dinitrophenol, DNP, has gained popularity in some niche cultures, mainly bodybuilders, athletes, even in the modeling industry. It is a absolutely terrible compound for anyone to use because it's highly fatal if your body temperature goes too high. Hyperthermia will kill you. And indeed many people have died using dinitrophenol as a weight loss drug or attempting to use the weight loss drug. But dinitrophenol really illustrates a principle which is that your metabolism includes things like thyroid hormone and growth hormone, etc. But your body temperature and the way you utilize energy is controlled by your nervous system. And the way dinitrophenol works is by changing the neurons and the way that the neurons that connect to fat, change the way fat burns up. So we are not going to suggest that you use dinitrophenol. However, there are other things that you can do that can change the relationship between these neurons and the fat of your body in ways that can powerfully accelerate fat loss. And I don't know why we don't hear about these things more but probably because most of what you see out there on the internet focuses more on what you could eat and should eat or shouldn't eat. It concentrates on exercise regimens which we will also talk about. But the burn factor, your thermogenic environment, is one of the, if not the most important factors in this business of fat loss. And since I'm a neuroscientist, that's what we're going to talk about. So let's talk about fat utilization. Let's talk about how fat is converted into energy which is sometimes also called fat burning. What I'd like you to know is that this is a two part process. Okay. In reality, there are many biochemical steps. And if you log onto the internet or you open up a textbook and you want to learn about fat utilization, you're going to see a lot of chemistry. And I'm happy to go deep into that chemistry if you like, but I think most of you are probably interested in what are the leverage points? Where can you exert control over this process in ways that benefit you? So I'm going to focus mainly on those. Okay. This is not to upset the aficionados and I will put in some nomenclature, but here we go. There's two parts to this process. One is fat mobilization. And the second is fat oxidation or utilization. Okay. So the first thing that has to happen for body fat to get burned up or used and reduced is that it has to get mobilized. And that's a process called like policies, but I actually don't care if you know the name like policies, you just have to move that fat out of the position that it's in. You have to get it out of the fat cells. All right. Fat cells can be visceral around our visceral organs or they can be subcutaneous under our skin. Most people are thinking about subcutaneous fat when they think about fat. So here's the deal. And if you want more detail, great. I'll touch on that in a bit, but basically stored fat has two parts that are relevant here. It's got the fatty acid part and that's the part that your body can use. And that's attached to something called glycerol and they're linked by a backbone. So already probably too much chemistry for both you, but what you want is you want to break the backbone. So if you just can remember to mobilize fat, you got to break the backbone between glycerol and these fatty acids. Okay. That's accomplished by an enzyme called light paste, but you can forget all that if you want. Remember, we're just trying to mobilize fat. So the first step is to get those fatty acids moving around in the bloodstream to get them out of those fat cells. And then they can travel and be used for energy. And that second part, remember, first part is mobilization. The second part is oxidation. Is then those fatty acids, those are potential fuel. They're just potential fuel, but you haven't burned the fat yet. You've just moved it out of your fat cells. They're going to go into cells that can use them for energy. And once they are inside those cells, they're still not burned up. You need to oxidize them. You think oxidation is the burn up part. They need to be moved into the mitochondria. And then they can be converted into ATP into energy. So just to really zoom out again to make sure I don't lose anybody. You got to mobilize the fat. Then you have to oxidize the fat. In other words, you have to mobilize it. Then you actually have to convert it into energy. If you just mobilize it and you don't convert it into energy, you don't oxidize it. It can be returned to body fat. And many of the things that the nervous system can do is to increase the mobilization of fat, but also the oxidation of fat. So you have two opportunities to burn more fat. And both of those opportunities are governed by your nervous system, by neurons that literally send little wires that we call axons into fat and release chemicals that provide a stimulus for more of that fat to be mobilized. And then later for more of that fat to be burned up. Okay. So we could go really deep on this, but I'm not going to go much deeper than that because this isn't a biochemistry of fatty acid metabolism lecture. This is about how to burn fat using your nervous system. But remember, there's a mobilization step. And then there's an oxidation step. I think anyone at view, all of you should be able to internalize that mobilize, then oxidize. Okay. Mobilize, then oxidize. So what are these neurons that connect to fat doing? What are they releasing exactly? How do they actually increase fat mobilization? And how do they increase fat oxidation burning of fat? Well, there are a couple of things that they release that encourage that process. And the main one that you need to know about is epinephrine or adrenaline. The conversion of these fatty acids into ATP in the mitochondria of cells is favored by adrenaline. Okay. And adrenaline is released from two sources. Adrenaline is released from the adrenal glands, which set atop our kidneys and are lower back. And it's also released from the so called sympathetic nervous system, although that name is a bit of a misnomer because it has nothing to do with sympathy has to do with stimulating alertness and promoting action of the body. There's a big mistake in the literature that is finally being corrected among those who know the mistake in the literature is that the adrenal glands and the release of adrenaline is what stimulates fat loss and fat oxidation. In fact, it was thought for a long time that adrenaline swimming around in your body of when you're fasted because fasting can increase adrenaline or when you're engaging in intense exercise or when you're stressed is going to promote fat oxidation. That's actually not the case. The adrenaline that stimulates fat oxidation, the burning of fat is coming from neurons that actually connect to the fat. Not hormones like adrenaline that are swimming around in your system. It's a local process. And this is very important because it means that what you do, the specific patterns of movements and the specific environment you create that can stimulate these particular neurons to activate fat meaning to release fat to mobilize it. And then to burn it is going to be a powerful lever that you can use in order to increase fat loss. So what have we said so far? We've said that you got a mobilizing, got a burn fat and that your nervous system is in control of that process. It's not just about calorie deficit. Okay, so let's talk about how to activate the nervous system in ways that it promotes more liberation movement, mobilization of fat and more oxidation of fat. So one of the most powerful ways to stimulate epinephrine, which is also called adrenaline, from these neurons that connect to fat and to thereby stimulate more fat mobilization and oxidation is through movement. But I'm not talking about exercise. The type of movement that I'm referring to is extremely subtle. And some of you may be familiar with this type of movement, but I'm guessing you're probably not familiar with what I'm about to tell you, which is that shiver or shivering is a strong stimulus for the release of adrenaline, epinephrine into fat and the increase in fat oxidation and mobilization. But shiver is not just induced by cold and there are other subtle forms of movement that can greatly increase fat metabolism and fat loss. There was a group in England during the 1960s and 70s that discovered a pathway by which subtle forms of movement can greatly increase fat loss. This is the work of Rothwell and Stock. It's very famous in the thermogenesis literature. And I learned about this early on when I was an undergraduate and I asked, how did they come across this? And here's how the story goes. They were aware that some people overeat and yet don't put on weight. Other people overeat even just a little bit and they seem to accumulate extra adipose tissue. Now this is long before all the discussions about microbiome and hormone factors and you know as long before it many of the hormone factors besides insolinity even been discovered. What they did was they examined people who overeat and did not gain weight. And what they observed was that those people engaged in lots of subtle movement throughout the day. In other words, they were fidgeters. That's what they call them. I'm not going to do the British, the British accent version of fidgeters. But Rothwell and Stock were British. What they found were people that overeat but don't gain weight as a consequence. And in fact, many people who had low levels of body fat had a lot of resting tremor, not of the Parkinsonian type, but they would bounce their knee while they were sitting. When they would talk, they would engage in very angular movements. They were sort of electric. In fact, now in science, I was chuckling about this as I was diving back into this literature because the other day I heard a wonderful lecture on a totally different topic from a colleague of mine. He's over in Europe and he's this tremendously successful scientist so we like to poke fun at him. And every one of his movements is incredibly electric and staccato. And he's rail thin and he eats like a horse. And so if it's very well into the discovery of Rothwell and Stock, who discovered that fidgeters, people that bounce their knee, people that have a head bob while they're listening, people that nod a lot, people that stand up and sit down a lot throughout the day. And people that pace burn anywhere from 800 to 2500 calories more than the control group in the experiments that they looked at. And indeed, there's been a modern look into all this and these numbers check out that simply moving around a lot, even if those are subtle movements, greatly increases the amount of energy that you burn. And people who overeat, the people who can have the second or the third donut or donuts at all and don't seem to put on weight to the same degree, they are people that move around a lot even when seated. They're people that will often move their limbs very quickly as well. There even have been studies that have explored other things that correlate with fidgeters. They stand up very quickly at the end of a lecture or they start to gather their things very quickly whereas non fidgeters don't. So dogs like my Bulldog Costello, definitely not a fidgeter. Every movement is incredibly slow and deliberate sitting down as a process if you ask them to sit down and sort of a slow motion, you ask them to get up and he kind of looks at you size and stands up. The fidgeters are the opposite of that. You say, how are you doing? They go great. So even sometimes their speech will be accelerated, although not always, but staccato movements, fidgeting, et cetera. And in 2015 and again in 2017, there have been studies that have explored this using some modern metabolic tracking. And indeed simply moving a lot, being a fidgeter, bouncing your knee, standing up and pacing several times or many times throughout the day, led to considerable amounts of fat loss and weight loss when people were ingesting the same amount of food. If they over ate, they were able to compensate and burn off that food. And if they were trying to lose weight and they incorporated this fidgeting protocol of deliberately trying to fidget more and move around during the day, pace, stand up more quickly, sit down more often, sit down and stand up more often rather. And they found that they greatly increased their weight loss anywhere from 20 to 30% increases. And in some cases, there are always those few people who burned a lot more. It seems to work best in people who are already slightly overweight. So for people that are overweight, who are kind of averse to exercise, fidgeting might actually be a good entry point. 800 to 2500 calories is a considerable amount of calories when you really think about it. Now, why am I telling you this? Well, there's clearly a tool to export from this, which is that you can increase the amount of calories burned without having to go on additional long runs. I do hope that people are exercising regularly because it's so important for other aspects of brain and body health. But nonetheless, we are all time limited and we are not all so ready to embrace exercise. I have a family member who has been slowly coaxed into exercise. But if I were to tell her, for instance, you need to fidget more, she'd probably go for it. This is a powerful way to increase the calories that are burned. Now, that's great. And you can think about the protocols. But I want to nest that protocol in what I said before, which is that that is controlled by these neurons and the epinephrine they release. You might say, well, how could these little micro movements lead to so much caloric burn? And that's where it really gets interesting. Rothwell and stock and others that they worked with subsequently found that these little fidgety movements, the engagement of certain aspects of our musculature that are nothing like exercise. It's not these large coordinated or rhythmic body movements, but rather subtle little bits of fidgety movement. And here I am doing a lot of fidgety movement. As an example, tapping the pen, this kind of thing. I was probably that kid in class most of the time. I was like, I try not to do it to irritate people. But I was definitely a knee balancer. I'm not particularly lean or not. But, you know, I was definitely, this is a common activity for me. People that do that sort of thing, it turns out that it's not the kind of caloric burn that we normally think of of like, oh, you're running, lifting weights, swimming, yoga, et cetera. Those subtle movements of our core musculature, not just the core, but all our limbs in our musculature, those low level movements. They trigger epinephrine release from these neurons and they stimulate the mobilization of fat. And then that fat is oxidized at higher rates. And I find this fascinating. I wish more people knew about it, which is why I'm telling you about it today. This has nothing to do with exercise in the traditional form. And yet 800 to 2500 calories per day. That's a considerable amount of fat oxidized. If you are in a calorie maintenance mode or if you're subcaloric, that's going to add to still additional fat loss. The data on this are tremendous. I'll link to a few studies. If you're really interested in learning about what's called neat, NEAT, which is non-exercise activity thermogenesis, neat. So what's the protocol, fidget. If you're really interested in burning calories and you already exercise, you want to burn more or you don't have the opportunity to exercise or your reversed exercise for whatever reason. Figuting movements, staccato movements, standing up, walking around, pacing, all the sort of nervous activities that we're so critical of in other people and sometimes in ourselves are actually mobilizing and oxidizing a lot of fat and a lot of energy. And while this probably won't compensate for chronic overeating, the caloric burn from this is considerable and very likely can offset a meal that had excessive calories or a kind of steady state of eating too much. And it also starts to open up all sorts of thoughts and discussion about when you travel, you tend to eat foods that are outside your normal ones. We tend to eat foods that aren't so great for us. We also tend to be a little bit more sedentary when we travel or on the plane, etc. But all of that aside, just the use of something like low level movement and it's almost like a tremor, but also these short, small, fidgety movements. I'm intentionally doing a lot of these today. So you have examples that you can use that to select from if you like. These can have a major effect on fat loss and it raises a second tool. If these low, meaning these small movements that we engage in trigger epinephrine adrenaline release from these neurons of the sympathetic nervous system that innervate fat and increase fat mobilization and oxidation. Now it should make sense why shivering is one of the strongest stimulus, stimuli that one can incorporate to stimulate fat loss. Now shivering is almost always associated with cold. We think shivering, we think cold because when we get cold, we shiver. And there are two ways that shivering can increase fat loss. And there are several ways that you can use shivering, you can leverage shivering and you can leverage cold to accelerate fat loss. But you have to do it correctly. And most of the people that are using cold and frankly suggesting cold as a means to increase metabolism fat loss are suggesting the exact wrong protocol. In fact, the one I'm going to recommend is 180 degrees in the opposite direction to the typical protocol that you'd hear about. Let's talk about how to use cold and how to leverage shiver as a particularly strong stimulus to increase fat loss through mobilization and oxidation of these fatty acids. So in recent years, there's been a growing interest in the use of cold for various things like improving stress tolerance, improving metabolism, recovery from exercise. I've talked about a number of those things and the uses of cold on this podcast. In fact, did an episode on how to supercharge performance through pulmercooling, cooling the palms in specific ways or the bottoms of the feet. And if you're interested in that and how to improve performance in endurance and strength, you can check out that episode. But most people out there are using cold exposure, typically by taking cold showers or by getting into cold water of some other kind, a lake or a river or a cold bath or an ice bath. And they are doing that probably with mixed goals, meaning they both would like to increase their metabolism and burn fat as well as improve mental resilience. Since today we're talking about accelerating fat loss through the use of science-based tools. I want to emphasize a study that was published in Nature just a couple of years ago showing exactly how cold increases metabolism and fat loss. So we have several kinds of fat, three kinds in fact. We have white fat, white adipose tissue, and we have brown fat or brown adipose tissue. And there's a third kind which is beige adipose tissue. White fat is the type that we traditionally think of as fat, subcutaneous fat. And it is not particularly rich in mitochondria, it is there as an energy storage site. And we have to mobilize the fat out as we talked about before and burn it up elsewhere. Brown fat largely exists between our shoulder blades and on the back of our neck, between the scapulae, and it's rich with mitochondria which is why it's called brown fat. And brown fat has a particular biochemical cascade whereby it can take food energy and it can take food basically, break it down and convert it into energy within those cells. And there's some additional steps involved. But unlike fatty acids from white fat which have to travel elsewhere, get broken down in mitochondria and convert into ATP, etc. Use by the mitochondria rather. Brown fat is thermogenic, it can actually use energy directly. It skips a step and I don't want to get diverted by going into all the biochemistry of it. The beige fat is sort of in between, it's white fat that could be brown fat because it has some mitochondria in it but not as many as brown fat. Now cold exposure does several things. Making ourselves cold can allow us to build up mental resilience because getting into cold of any kind doesn't matter if it's a cryo chamber, doesn't matter if it's a cold day and you forgot your sweater or your parka. It doesn't matter if it's an ice bath or you're lying down in the snow. Cold causes the release of adrenaline from your adrenals and it causes the release of epinephrine from these neurons that connect to fat. The big effects of cold on metabolism and fat burning are going to be through two routes. One is that if you expose yourself to cold, you have the opportunity to trigger activation of brown fat as well as to convert more beige fat into true brown fat. So you essentially create a stronger or a hotter furnace. That's the way to think about brown fat. It's like a furnace. And so with this principle that we started with of calories in versus calories burned, what you're doing is you're increasing the amount of burning, you're increasing the burn of energy by increasing the intensity of the heat inside you so to speak. And talking here is kind of metaphorically. Now, how can you do that? Well, if you get into cold water or an ice bath or a cold day and you try and remain calm and resist shivering, you actually short circuit this mechanism for increasing brown fat thermogenesis. The paper published in nature shows that it is shivering itself that causes the brown fat to increase your burning, your burn rate and your metabolism. And it works like this when you get into cold and you shiver the shivering those that low level movement of the muscle, those small movements triggers the release of a molecule called sukinate succionate and sukinate acts on the brown fat to increase brown fat thermogenesis and fat burning overall. It actually increases body heat through this brown fat thermogenesis pathway. And it also over time can increase the amount of brown fat by converting beige fat into true brown fat. Now, how much cold exposure and how often that's the key. But before I give that detail or set of details, remember, if you resist the shiver, you are not going to get the increased metabolic effect because you are not going to get the sukinate release. So if you want to get your body heat, your thermogenic level to go up, you need to shiver. So now we have the neat, the non-exercise activity thermogenesis, so low levels of activity, as I described before, which are done away from cold, maybe do them in cold as well, as well as shiver in response to cold. And so the shiver itself is valuable for triggering the release of sukinate. In fact, sukinate is being evolved now by various drug manufacturers as a potential treatment for obesity, although it hasn't really hit the market in its final form yet. So sukinate is powerful for its effects on brown fat. So how many times a week do you need to expose yourself to cold will depend on how much fat you're trying to lose and how much you're trying to increase your metabolism. There are studies that describe positive effects on fat loss of exposing yourself to cold either through cold shower or through ice bath or other cold water. So I have to actually have ice in it provided it's cold enough for any time anywhere excuse me between one and five times per week, but it turns out that just one exposure per week can be valuable. The question then is how long to get into that cold environment and how cold should that environment be. So first let's talk about how long to get into that cold environment. The answer here might be a little bit different than you might imagine. Most of you might think oh well if one minute is good, three minutes is better and if three minutes is better than 10 minutes is best. But remember the goal is to get the shiver induced release of sukinate so that sukinate can trigger the brown fat. It turns out that if you want to trigger the shiver what you want to do is to get into the cold and then get out of the cold and typically not dry off and then get back into the cold and out of the cold that will definitely stimulate more shivering than just getting into the cold itself. So what I'm not referring to is getting into the cold environment like an ice bath and waiting until you shiver and staying there shivering. You also don't want to get hypothermic and I want to be clear you want to get approval from your doctor before you do any of this. When you get into cold water there are two factors that will dictate whether or not you shiver probably three but let's just talk about the main two. One is how cold it is so how cold should it be and look if you get into water that's very very cold it can actually shock your heart. It can actually give you a heart attack if it's truly truly ice cold and you're not adapted to that so proceed with caution please I'm not a physician and I'm not I don't want to see anyone get hurt. Cold just cold enough to be uncomfortable is a good place to start so for some of you that's going to be 60 degrees for some of you that's going to be 55 degrees for some of you it's going to be. High 30s depends on how cold adapted you are and people vary in terms of how well they tolerate the cold so what you need to do is find a temperature that you can get into one to five probably one to three times a week if you really want this to accelerate fat loss and you want to get in until you just start to shiver and then you want to get out and not dry off. Wait anywhere from one to three minutes and they get back into the cold now you'll notice when you get back into the cold it'll almost seem soothing it might actually not induce shift it might take away the shiver that you were that you had. So here's a potential kind of sets reps protocol that you can play with find a temperature then do some shiver for you that's going to vary depending on your cold tolerance and how cold adapted you are one to three maybe five times a week. Get in until you or get under the shower or whatever it is until you start to shiver genuinely shiver then after about a minute or so get out spend one to three minutes out but don't try off get back in for anywhere from one to three minutes but try and access the shiver point again and you might do three repetitions of that so it's three times in and three times out total. Okay that's a great starting place and what you don't want to do is build up your tolerance to cold so fast that pretty soon you're able to resist the shiver because remember the shiver is the source of the sukinate release that will trigger brown fat thermogenesis. So if you'd like to see this protocol spelled out you can access it zero cost at a website which is the cold plunge dot com the cold plunge is a company they make cold plunges and they were kind enough to gift one to the human lab podcast but I want to emphasize that these protocols are free of cost the folks at the cold plunge are not just interested in marketing their product but one of their main interest is encouraging people to engage in cold exposure for particular end points and goals like fat loss resilient. So that's not a bad loss resilience etc resisting inflammation but their main focus is providing people protocols and encouraging people to use cold exposure various kinds not just through their products but through cold rivers and jumps in the ocean and things that cold showers whatever is most convenient and accessible for various people and so we needed a place where we could house these protocols in a permanent way and not just for this episode but we could have a chance to get a chance to do it. So but so what they've agreed to do is to post the protocols there they should be very easy to find on their website this particular protocol we're referring to as the fat loss optimization protocol for lack of a better name and it's really grounded in how cold can be used to induce shiver and again it doesn't really matter how you're accessing that cold provided you access the shiver and you're moving from the cold environment to a slightly warmer environment so getting out of the cold shower or getting out of the ice bath etc or out of the cold plunge and then back in because it turns out that the cooling and re warming process of the body is where shiver kicks in and so that's distinctly different than just trying to get into the cold and stay in the cold for as long as possible and if you zoom out a little bit and think about some examples in life you'll understand why that must be the case. For instance people who do a lot of cold water swims you have these polar bear clubs I think they call themselves do these cold water swims I would sometimes see these people swimming back and forth the alcatraz and stuff like that which just seems risky and you know they tell me is very stimulating for the mind and body great sometimes those people are very lean oftentimes they're not and they're getting a lot of cold exposure and one of the things that happens is if you expose yourself to cold over and over you adapt you become cold adapted and when you do that you no longer get the epinephrine the adrenaline release from the cold and therefore you don't get the sukinate release and the shivering and the brown fat thermogenic effect quite as intensely. So if you want to use cold for other reasons it certainly cold water swims can be fun and there's you know long as you can do them safely they're great I've done gotten into cold water swimming for some period of time you can use cold for resilience etc but if you want to use cold to increase fat loss then getting this shiver process going the cooling and re warming which accelerates the amount or increases the amount of shiver that's going to be the way to go. One note about cold and some of the factors that it releases a few years back there was a lot of excitement about this hormone called irisen irisin which was associated with cold and there was a lot of excitement about its potential role in increasing metabolism so much so that people were starting to explore this as a potential fat loss drug. To my knowledge that went nowhere the science eventually shifted over to sukinate as the main factor in cold induced thermogenesis through this brown fat pathway but if anyone out there is aware of any positive effects of irisen or you know of any science of irisen that I'm overlooking here or that I'm speaking about incorrectly please let me know I'd be very curious to learn. Now I want to just talk about brown fat a little bit more and talk about a period in your life in which you were rich with brown fat you had a ton of brown fat and that's when you were a baby. Babies can't shiver. These neurons that release epinephrine into fat are not wired up and really aren't present at sufficient levels or in sufficient numbers when you are a baby and therefore you can't shiver as a baby and you can't warm yourself up in cold environments very well. To compensate for that mother nature installed in all of us an excess of brown fat early in life that exists again in the upper back in the middle of the back and the back of the neck. Over time if we don't expose ourselves to cold environments or do other things that make a shiver we lose a lot of that brown fat. But what's interesting about brown fat is that there's some evidence that brown fat just like white fat can both increase in size but that you can also add new cells. Now there's a little bit controversial people always say you can't change the number of fat cells you can just shrink them or increase their size. Well it turns out that epinephrine released from these little nerve endings in brown fat and succinate circulating in the body may and I want to underscore may have the effect of increasing the amount of brown fat cells probably by converting these beige fat cells into brown fat. So that allows us to become much as we were early in life where we metabolized like crazy and we'd heat ourselves up without shivering. Some people have taken the cold thing to the extreme you know putting ice packs on the back of their neck throughout the day. I did episode all about testosterone and estrogen and there's this let's just call it a very niche I have to imagine very very niche culture of people who are wearing literally I'm not joking they are these cool pack ice pack underpants they go by a name that I'm not going to repeat on here but you can find them on Amazon. That's those are people that are using cold packs on the body and on the growing to try and increase things like testosterone. But as well to try and increase thermogenesis and trying to increase their metabolism just remember if you become cold adapted you're not going to get the fat burning effects to the same degree. So cold is a powerful tool for fat loss but you don't want to adapt this is reminiscent of a rule that you hear about in endurance exercise and in strength exercise as well which is that you want to use the minimal effective stimulus to promote growth or progress or growth of the muscle or improvements in endurance. If you go 10% further on a run or you know 10% faster you will likely see an improvement in performance provided your recovery the next time you come back and do that same round of exercise you'll be able to do more work or complete the work more easily et cetera you've adapted. If you do 20% more distance or 20% more weight you won't necessarily see the same commiserate level of gain or improvement and so likewise with cold if you're quickly moving from 30 seconds of exposure to 10 minutes of exposure you're overlooking the opportunity to get the most fat loss and increase in metabolism by stepping it up in smaller increments. Okay and this also speaks to the rationale for using cold exposure to accelerate fat loss for certain periods but then maybe not doing it year round if fat loss is your goal maybe use it for two three months at a time and then stop for two three months at a time because it is such a potent stimulus provided you engage in the in the shiver. Next I'd like to move to exercise and how particular timing and types of exercise can vastly improve fat loss. Before I do that I just want to mention a really important reference for those of you that are interested in learning more about how neurons connect to fat. This is certainly a paper that you'd want to look at if you're interested in diving deep into the literature and reading all the various studies. It's a review and the title of the review is neural innovation of white adipose tissue and the control of light policies. It was published in frontiers in neuroendocrinology. You can find that free online. They have the full text available. The first author is Bartness B-A-R-T-N-E-S-S. It's a great review and I've talked about a number of things that are mentioned in the review. Follow the references in that review and the reference trail as we say if you're interested in learning more about also how neurons control brown fat. Before I move to exercise I also just want to highlight something that comes up every few years and has largely been considered myth now but that is actually more interesting than most people might think which is this issue of spot reduction. In the 80s and 90s there were a lot of commercials, light night infomercials where they would talk about spot reduction. If you do sit ups will you lose abdominal fat if you do hip raises or glute raises where you lose glute and hip fat. I think everybody now believes that and understands that fat metabolism is something that happens systemically throughout the body. That somebody fat is quote unquote more stubborn than others. Everyone varies and where they tend to store fat or lose fat last. A number of factors that influence that in particular hormone receptors. But now at least in the scientific literature spot reduction and the possibility of real true spot reduction, reductions in fat in a targeted way, a body part or body area targeted way is becoming more of a reality and maybe a reality soon. Because exercise that triggers the activation of these nerve fibers, these neurons that innovate fat. In theory if you can increase the amount of epinephrine released at those particular fat pads as they're called, they're actually called fat pads in the scientific literature. In theory you could increase mobilization from those particular body fat sites. Because the new view that the modern understanding is that it's not adrenaline release systemically kind of bathing all your fat tissue. But rather it's neurons releasing adrenaline epinephrine locally that in theory exercise that stimulates the release of epinephrine or exercise coupled with things like shiver or low grade shaking movement or the neat, the non-exercise activity thermogenesis. Could in theory lead to local enhancement of mobilization of fat tissue. So I think that spot reduction actually will soon be something that's possible using the appropriate technology. What does this mean for you now? What could you possibly do for this with this information now? Well I think it speaks to the fact that if one is going to engage in exercise that doing exercise that involve lots of different body parts and movements is likely to encourage the maintenance and or growth of these neurons that innovate fat throughout the body. What this means is changing up the pattern of exercise engaging in novel types of movements may actually be one way that one can access the so called stubborn body fat pads. Now there's a little bit of speculation in the statement that I'm making. But if you think about it makes sense if you become very adapted to a particular pattern of exercise whether or not you're subcaloric or not you're a maintenance calories or not. You are oxidizing some fat always and you're utilizing the neurons that innovate fat in a regular way and pretty soon this innovation is going to shut off because there's no reason why this neural innovation of fat should continue to release epinephrine unless you give it a strong stimulus like cold or the fidgeting or in this case to do novel forms of exercise. And there's some anecdotal evidence and there I don't even want to call it data but anecdotal evidence that people who have quote unquote stubborn body fat if they start to adopt new patterns of exercise they can start to access those stubborn fat pads and again fat pads is the correct way to refer to these in the scientific literature. So what we're focusing on today is the fact that fat indeed will be mobilized and oxidized in response to a deficit in calories but that the way that neurons control those fat pads and those body fat stores afford you a lot more control than perhaps you ever previously thought. Let's talk about movement and the more traditional kinds of movement aka exercise has been shown to lead to increases in metabolism and fat loss to greater degrees depending on whether or not for instance you're fasted when you do it or not whether or not you do your cardio first or your resistance training first. And this is again and a literature for which there's a lot of controversy but in digging through all the studies on on this we're finally starting to arrive at a consensus of when is best to do exercise and what types of exercise to do if your goal is fat loss. The topic of exercise is a kind of controversial one not as controversial as nutrition and diet which we will talk about in a few minutes but it's a particularly interesting one because different types of exercise engage the musculature of the body and the heart and the lungs in different ways and can have vastly different effects on things like hormones and metabolism depending on whether or not it's of high intensity modern intensity or low intensity. So rather than think about weight training versus cardiovascular exercise I think the most simple way the most fluid way to have this conversation about exercise and fat loss is in terms of three general types of training whether or not it's done with weights or body weight doesn't really matter. And those are high intensity interval training something that seems to have gained a lot of popularity in recent years so called hit H I I T so high intensity interval training sprint interval training so that's going to be very high intensity or S I T or moderate intensity continuous training M I C T so we've got hit sit and micked M I C T. And we can get a little bit more precise if you'd like I'm not somebody who measures my VO 2 max or anything while I exercise I generally know whether or not I'm doing something I could continue for a very long time or whether or not I'm doing something that I realize is going to be a short duration high intensity but if you'd like to map this to VO2 max S I T this sprint interval training was defined as all out greater than 100% of VO2 max burst of activity that last is a great opportunity to do. So that's the activity that last eight to 30 seconds interspersed with less intense recovery periods this would be sprinting down field for eight to 30 seconds then maybe walking back for about a minute or two and then sprinting again and then continuing so that would be S I T hit H I I T and as sub maximal so 80 to 100% of VO2 max burst of activity that last 60 to 240 seconds interspersed with less intense recovery periods so on a standard 400 meter track just to give us a little bit of a visual you won a four minute mile would be fantastic for most people although people run faster than that of course so that's for 60 second laps but that's back to back to back I think in my you know in my best shape or maybe it was in my dreams I don't recall which I was able to do. 60 seconds around the track but of course I couldn't get that on the second or third or fourth if I did that was certainly in fantasy land and not reality but 60 seconds would be about one revolution around the track maybe maybe 90 seconds depending on how fast one is running so 60 to 240 seconds m I C T this moderate intensity continuous training is steady state cardio sometimes called zone two cardio these days on the internet which is performed continuously for 20 to 60 minutes at moderate intensity of 40 to 60% of VO2 max or if you prefer heart rate 55 to 70% of max heart rate. So we can think about high medium and low intensity exercise although low intensity usually means that you could carry on a conversation or maybe you have to gasp every few steps or so while trying to talk and run that's I think of going to be the most useful way to have this conversation that we're having now because there's so many different forms of exercise that people do and intensity is important. Let's ask the question that I think many of people are wondering about it which is is it better meaning do burn more fat if you do your exercise fasted and fasted in this respect could be that you wake up in the morning you've been fasting all night you just hydrate and you exercise or sometimes people ingest caffeine there's controversy as to whether or not that quote unquote breaks the fast has to do with whether or not your caffeine adapted something for another rep. In any case that would be fasted so probably not having eaten anything for anywhere from three to 24 hours or maybe even more as you could also be fasted in the afternoon if you had lunch at noon and it's four or five or six p.m. is it will you burn more fat if you exercise without in eating anything first without ingesting any calories first and people have tried to really split hairs on this every which way people say well you can fat fast because fat and protein doesn't lead to as great increases in insulin as other things maybe you can have a few almonds and then still train indeed insulin will prevent fat oxidation. I want to be really clear the burning part of fat and the cell the movement of the fatty acid and to mitochondria and the conversion to ATP insulin inhibits that process however it's been shown that at least for short periods of training it doesn't really seem to matter whether or not you eat before training or you don't if your goal is fat oxidation. I want to put a nasteryx near that because there are some exceptions but there were several studies done that and the kind of the classic ones of these I'll read out to you they what they basically did is they gave people glucose sugar blood to increase their blood sugar before training or not and the kind of classic study of this is alborg at all so 1976 so goes way back which is that glucose reduces fat burning in exercise. And then some other other studies if you want to look these up they're very easy to find on PubMed you put in Horowitz 1999 Lee Lee et al is another one where they have people drink milk with glucose in it so sweet sugary milk before exercise et cetera and you can find a number of examples where eating before exercise reduces the amount of fat that's oxidized during the exercise and you can also find a lot of studies showing that eating during exercise will or prior to exercise will not reduce the amount of fat that oxidize however the types of exercise whether I was medium intensity or high intensity or low intensity is all over the map for these studies so it's very hard to target an ideal protocol. And then if you look really deep in the literature you start to find meta analyses where people have actually aggregated all the findings and some modern studies where it points to some very specific and useful protocols and so here's the rule that or the protocol that I extracted from that literature. At a period of about 90 minutes of moderate intensity exercise want to be clear after at about or after 90 minutes of moderate intensity exercise there's a switch over point whereby if you ate before the exercise you will reduce it's excuse me you will burn far less fat from the 90 minute point onward then you would if you had gone into the training fast it so let me repeat that if it's moderate intensity so called zone to cardiotype exercise at the 90 minute point if you happen to have eaten before the exercise within one to three hours prior to the exercise then you reduce the amount of fat that you will burn from 90 minutes onward whereas if you had fasted prior to the exercise you hadn't eaten anything for three hours or more prior to the exercise at the 90 minute point you will 90 minutes of exercise you will start to burn more fat than you would had you eaten. Now 90 minutes of moderate intensity exercise is a lot so that's a that's a pretty long run even if you're running at a pretty slow pace like a 10 or 12 minute mile that's a lot of running that's a lot of swimming so that's a lot of walking that's a lot of hiking so however there are people who are going out hiking all day or running all day or walking all day and if you want to burn more fat per unit time you want to oxidize more fat then you would do that fasted Now there are also studies that point to the fact that you don't have to wait to 90 minutes in order to get this enhanced fat burning effect. The studies I was able to find and that looked to me like quality peer reviewed studies with no company bias or no product bias of any kind are studies that were largely funded by the federal government in the university context pointed the fact that if one does high intensity training or even the very high intensity forms of training like sprints or squats or deadlifts or any kind of activity that can't be maintained for more than these you know eight or I would say up to 60 seconds so a set of lifting weights repeated repeated if that's done for anywhere from 20 minutes so weight training or powerlifting or these kinds of things or kettlebell swings or up to 60 minutes well then the switch over point in which you can burn more fat if you go into that fasted comes earlier and this makes sense because there's nothing holy about the 90 minute point for medium intensity zone to cardio that 90 minute point is the point in which the body shifts over from mainly burning glycogen basically sugar that comes from muscles or the liver and realizes this is going on for a while I'm going to shift over to a storage site fuel that is in reserve like body fat it's this is going to happen for a while so I'm going to start tapping into body fat stores now fat doesn't have a little brain there it is in a way by neurons but doesn't have thoughts and you don't actually control this switch with your mind this is something that has to do with the milieu of various hormones what has to happen is insulin has to go down far enough so if you eight before the exercise you have an increase in insulin if you eight carbohydrates you have a bigger increase in insulin fat and proteins indeed will have lower amounts of insulin and fasting will give you the lowest amount of insulin well then that switch over point is going to come earlier in the exercise and if you think about if you were to do something high intensity for 20 30 40 minutes maybe lift weights and then get into zone to cardio if you are fasted the literature says that you're going to burn more body fat per unit time then if you had eaten before or during the exercise so what does this means this means if you want to burn more body fat if it's in your protocols and you're you don't have been approved to do this safely exercise intensely for 20 to 60 minutes the higher the intensity obviously the shorter that bout is going to be and then move over into zone to cardio and if you do that fasted or the medium intensity cardio I should say and if you do that fasted then indeed you will burn a higher percentage of body fat if you need to eat or you like to eat before you train that also can work and if you train very intensely you're likely to shift over to the fat burning pattern more quickly as well so again this isn't really an issue of how long you exercise it's an issue of how intensely you exercise and therefore what fuel source you're drawing from so hopefully I've made that clear but basically you need to to complete glycogen or through high intensity exercise and then move to a steady state exercise that will allow you to burn more fat or you need to perform a medium intensity or low intensity type exercise for a long period of time before you shift over to burning fat and indeed it seems that going into all that fasted will facilitate the burning of more fat overall but if you can't even get to the exercise if you're somebody who just can't do the training at all you're unwilling to or you're incapable of training unless you eat something then obviously eating something makes the most sense and what you eat prior to exercise that's a whole other is that people argue about and fight about whether or not you should go into it with low carbohydrates or higher cover all of that but in general the theme there is very simple which is that you want insulin levels to be pretty low if your goal is body fat reduction if you want to oxidize body fat so fasting in some cases fat fasting in other cases where you're just ingesting fats fat and protein in some cases or for some people it will be eating carbohydrates I'm not here to dictate a particular nutrition regimen that's just how the hormone balance of these things and fat oxidation works now one thing that's very interesting and cannot be overlooked is this issue of how much energy you burn during and after the activity and some of you probably already know about this but the whole business of calories calories in versus calories out and people counting their number calories they burn during their aerobic session or during their whatever session is only one half of the equation and it really eclipses the more important issue which is how much of an increase in metabolism does a given exercise create after the exercise and we could talk for hours about this but the simple way to view this is that high intensity training anaerobic training of weight training sprints burpees any kind of thing I don't know these days I see I hear you're not supposed to do burpees that people think burpees are danger so I'm not suggesting particular movements here you have to decide what's right for you I do burpees I don't I don't seem to be injured from them but I hear that they're terrible for some people so anyway push up sit ups whatever happens to be that anaerobic exercise that's of higher intensity or sprints taps into glycogen stores during the movement and will burn more energy per unit time than modern intensity high intensity burns more than modern intensity that's straightforward what's interesting is that all the studies that I was able to find on what happens after that type of exercise showed that the percentage of fat that you burn after high intensity exercise is actually greater in other words you burn a lot of glycogen during the high intensity exercise and then after the exercise the post exercise oxygen consumption is sometimes called goes up we know this after you train intensely that post exercise oxygen consumption goes up sometimes for up to 24 hours and it is during that period of time that you oxidize more fat not glycogen now what's interesting is that the reverse is also true for people that do long bouts of low or modern intensity exercise so typically this would be things like running swimming biking etc so 60 90 minutes two hours maybe even people that are training for marathons or half marathons when they stop training they burn more glycogen more carbohydrates even though they were burning more body fat per unit time during the low intensity exercise so there's this kind of inversion high intensity burns more glycogen during the activity more body fat afterwards moderate to low intensity burns more percentage wise more body fat is oxidized than glycogen during the move during the actual exercise afterward it's more glycogen so I don't want this to get too complicated the point is you should pick exercise that you like that you're going to do regularly but it does seem that the high intensity exercise followed by moderate intensity exercise is going to be optimal for fat burning overall because when you look at the percentage of body fat burned and you look at the overall increase in basal metabolic rate moderate and high intensity training followed by low intensity training or even just followed by going back into life is going to be the best way to continue to burn body fat because the way it increases basal metabolic rate this could be distilled into a simple protocol whereby three or four times a week you do high intensity training followed by either nothing or followed by low intensity training especially if you're able to do that fasted and I should just mention that none of this stuff about fasted is about performance if you want to perform really well you want to hear this is for reasons of performance and you want to you know it's for a sport or a competition it's not for body fat purposes well then all this kind of falls away and is modified by what's ideal to eat for performance but what we're talking about today is how to optimize body fat body fat loss so train moderately to intensely to very high intensity and then moderate to low intensity or train moderate to high intensity and then go about life and in fact I have a friend who uses this strategy he likes to train intensely and not that often protocol because he's a very busy person so he'll train for 20 to 30 minutes intensely with weights or just body weight movement doing a lot he does burpees and pushups and sit ups and pull ups and just kind of moving and kind of circuit type training but where he's breathing really hard the goal he always says is I want to breathe hard for 30 minutes every day and then afterwards he hydrates and drinks coffee and moves into his day and he's walking around and taking calls and carrying around his children and doing all these kinds of things that keep him really busy was kind of like low intensity work so I think you get the principle now but you should all be asking yourselves as scientists of yourselves why would it be that certain patterns of exercise would lead to more or less fat loss it can't just be about the energy burn we already established that and again it has to do with the neurons it has to do with how we engage the nervous system so while non-exercise activity induced thermogenesis neat the fidgeting and cold can induce thermogenesis by engaging shiver type movement or low level movements big movements that are of very high intensity meaning they require a lot of effort deploy a lot of adrenaline epinephrine from our neurons and signal particular types and amounts of fat thermogenesis fat oxidation whereas low level intensity exercise low or modern intensity exercise walking running biking where you can do that easily there's not very much adrenaline release so adrenaline and aka epinephrine is really the final common path by which movement of any kind whether or not it's low level shiver whether or not it's lifting a barbell sprinting up a hill or doing a long bike ride adrenaline is the effector of fat loss it's the trigger and it's the effector so now I want to turn our attention to compounds that increase epinephrine and adrenaline as well as compounds that work outside the adrenaline epinephrine pathway to increase the rates of fat loss I almost always save compounds and supplements and things of that sort to the end because I do believe that people should look first toward behavioral tools and an understanding of the science before they look toward a supplement or a particular thing that they can extract from diet this is mainly to try and shift people away from the kind of magic pill phenomenon or the idea that there is a magic pill because there really isn't and frankly there never will be but there are some compounds that can greatly increase fat oxidation and mobilization and understanding which compounds increase oxidation or mobilization and be very useful if your goal is to accelerate fat loss there are things that people can ingest that will allow them to oxidize more fat and that occurs mainly by increasing the amount of epinephrine that is released from neurons that innervate fat tissue one of the more common ones is one that you may already be using which is caffeine well established that caffeine can enhance performance if your caffeine adapted I talked about this in an earlier episode so I want to make sure I'm very clear about this if you are not used to drinking caffeine and you suddenly decide I'm going to drink a big cup of coffee before training you will vasoconstrict and you will limit performance so that's performance if your caffeine adapted however there is this kind of interesting phenomenon where ingestion of caffeine serves more as a performance enhancer both by increasing alertness but also by way of dilating vasculature of allowing more blood flow now caffeine for burning more fat for oxidizing and mobilizing more fat is an interesting one it can be effective at dosages up to 400 milligrams you have to be careful if your caffeine sensitive some people have just a little bit of caffeine and their mind is crazy and they're very uncomfortable it can have cardiovascular effects for some people with hypertension etc so please check with your doctor but 400 milligrams is roughly a cup and a half a coffee or two cups of coffee nowadays there's a lot more caffeine in coffee so if you go to a typical cafe and you were to get their medium size that would have close to a gram of caffeine which is why if you're a regular caffeine consumer and you don't get that gram of caffeine in your coffee each day you will get a headache it can cause constriction and dilation of blood vessels in ways that's complicated but you'll get a headache some people like the way they feel drinking 100 to 200 300 maybe in 400 milligrams of caffeine before training and indeed that will lead to increased fat oxidation it will do that because you will release more epinephrine and adrenaline so let's just place this in the context of what we said previously let's say you normally do zone to cardio so you're going out for a moderately intense run for 30 to 60 minutes or so I think the current recommendation guidelines in the states are that people engage in 30 minutes of moderate intensity exercise five days a week for so that's 150 minutes if their goal is to improve or maintain health of the cardiovascular system 80% of people in the United States fail to do that or anything close to it they're weight we are way below threshold for what the government has recommended in this case the government recommendations I think are pretty good that's one could always do better of course but 80% of people aren't even doing that however just using the logic and the understanding of how epinephrine adrenaline is affecting this fat oxidation process if you were to go out for 15 minutes and you drank caffeine before you went yes you will probably oxidize more fat per unit time can you compensate for the exercise you're not doing just by drinking caffeine well probably if you were just talking about fat loss if that caffeine makes you fidget a lot right the amount of calories that you burn in a 30 minute run unless the run is very intense and you're wearing a weight vest and it's not that great right you probably get you know and somewhere into the 400 500 calories burned area but I said earlier and there are a lot of data now support that fidgeting for a day can burn anywhere from 800 to 2500 calories a day so you might say well fidgeting is better than running ah but it doesn't trigger the activation and the positive health effects of the cardiovascular system so fidgeting alone can be great but you need exercise for other reasons caffeine can enhance the amount of fat that you burn in any duration of exercise and it can shift the percentage of fat that you oxidize compared to glycogen unless you take that caffeine and it ramps you up so much that you're training really really intensely the bottom line is if you like caffeine and you can use it safely ingesting somewhere between 100 and 400 milligrams of caffeine prior to exercise somewhere between 30 to 40 minutes before exercise can be beneficial if we're talking about fat oxidation burning more body fat so that's caffeine there are a number of other things that have existed over the years that are in this pathway things like a fedron which is now illegal in most states I think maybe in all states because people are dropping dead from taking a fedron because they were heating up too much it's interesting there it wasn't direct effects on the heart causing heart attack it could trigger by way of adrenergic receptors if you'd like to know increases in body temperature and heat now there those drugs turned out to be dangerous because people are overheating and dying there was also the big fen fen craze there was a drug that was released fen fluoramine which actually was quite effective as an anti obesity drug a treatment for obesity that had to be outlawed as well it was FDA approval was removed because again people were dying because a cardiovascular effects I don't know if people were overheating on it as well so what is the solution if caffeine is the kind of the entry point for most people of using compounds to increase the rate or percentage of fat loss in exercise and even at rest what are some of the other things that are useful and interesting well in terms of tools that are actionable and have reasonable safety margins I've talked before about something called GLP1 this is something that can be triggered by the ingestion of yerba mate which is a tea I guess because half Argentine they grew up drinking mate I think I was drinking mate from the time I was about three or four years old I don't suggest that for kids I don't think kids should be ingesting caffeine but anyway I did it and I still ingest mate mate increases GLP1 GLP1 is in the glucagon pathway so let's just quickly return to our biochemistry as you recall fat is mobilized from body fat stores and then it's burned up it's oxidized in cells it actually needs to be converted into ATP and those fatty acids are essentially converted into ATP in the mitochondria of the cell high insulin prevents that from happening and glucagon facilitates that process through increases in GLP1 the short takeaway is mate increases GLP1 and yes increases the percentage of fat that you'll burn it increases fat burning and that is especially true it turns out from the scientific literature if you ingest mate prior to exercise of any kind so if you want to burn more fat drinking mate before exercise is good drinking it at rest when you're not exercising will also help shift your metabolism toward enhanced burning of fat by increasing fat oxidation there's a whole category of pharmaceuticals that's being developed right now that are in late stage trials or are in use for the treatment of diabetes which capitalize on this GLP1 pathway there are go by various names and there are people on the internet who are selling these things they are prescription drugs and I want to emphasize that they are prescription drugs and you obviously wouldn't want to use any of these without a prescription and a requirement they does seem that they are effective for the treatment of certain kinds of diabetes and lead to fairly significant weight loss and reduction in appetite this is kind of the modern version of GLP1 is pharmaceuticals of GLP1 metabolism are drugs such as somatical I can never pronounce this can't seem to pronounce many things it seems somaglutide is the the way I would pronounce it S E M A G L U T I D E semaglutide but that's not the way you pronounce it but somatical I does the way that it's been described on the internet in any case this compound increases GLP1 it's actually a GLP1 analog in some cases and they go by various types of trade names so the GLP1 pathway is interesting most people including myself are not interested in taking a prescription drug to increase GLP1 I do it through the ingestion of mante mante leaves pour water over it and drink it what's kind of interesting that's not often discussed is that you can increase the amount of GLP1 by you can essentially reuse the T the the first time you drink it it's going to be very very intense and in fact some people find that that mante almost tastes like burnt leaves it's too intense you don't want the water to be too hot but I learned this trick from a friend you can reuse the leaves over and over again probably for about a day before they go bad and in doing that you start to extract more and more of the compounds from the mante leaf that increase GLP1 so it's kind of cool you can kind of get an increased effect so what I'll typically do is make a about 16 to 30 ounces and just sip it throughout the day and I do like it before I train some people who don't like mante might prefer something like guayusa which is spelled GUA YUSA GUA YUSA GUAYUSA which is from Ecuador despite the USA ending to it's from Ecuador and it's a it's a sweeter tasting tea it doesn't have any sweetener in it but the leaf of the guayusa plant is sweeter than the mante plant I sometimes will mix the two and then make the tea with that there's no mante or guayusa sponsor the podcast these are just tools to increase GLP1 and fat oxidation and again the semaglutide is the prescription version of the heavy artillery GLP1 stimulant and again should be only explored with a prescription so those are the compounds that that really increase fat oxidation directly there are going to be a number of things that impact insulin and glucagon that are going to shift the body toward more fat burning we talked about a lot of these during the episode on hormones we talked about it we did a whole episode on hormones in metabolism and so for instance burberine which comes from a plant or metformin are compounds that are now in growing use for reducing blood glucose they are very potent at reducing blood glucose which will reduce insulin because the job of the hormone insulin is to essentially manage glucose in the bloodstream so there are huge gallery of compounds that will reduce insulin and thereby can increase fat oxidation and that's because as I mentioned before fat oxidation this conversion of fatty acids into ATP in the mitochondria is inhibited by insulin so if you keep insulin low you're going to increase that process which brings us full circle back to the issue of diet and nutrition there is really solid evidence from the Gardener lab at Stanford and from other lab showing that when you look at different diets you look at low fat diets high fat diets keto diets intermittent fasting provided people stick to their particular diet it doesn't really matter which diet you follow you can still get a chloric diet you can still get a chloric deficit and you get weight loss adherence however is always an issue and so what I always say is that you want to use the eating plan that is obviously beneficial to your health but the one that allows you to adhere to whatever it is that the particular nutrition protocol is right if you can't stick with something then it's not very worthwhile but it's a purely scientific standpoint there's also an advantage to keeping insulin low now that doesn't necessarily mean you go to zero carbohydrate I've talked before my preferred way of eating is to go low or no carbohydrate throughout the day for alertness to get that adrenaline release and the focus that goes with it et cetera and the ability to think and move and do all the things I need to do during the day and then I eat carbohydrates at night because it facilitates the transition to sleep that's what works for me but when insulin is low you do place your system in a position to oxidize more fat and so that's why I think a lot of people do see benefit from lower carbohydrate or moderate carbohydrate diets because when insulin is low you are in a position to oxidize more fat both from exercise and at rest and I should mention because I often mention and it's appropriate to mention that if you're interested in looking at the effects of caffeine of mate guayusa things of that sort GLP1 you want to learn more about those you can go to this wonderful website which is free examin.com you can put in your bamaathe it will describe the three studies that show increased fat oxidation both during exercise and at rest and it's a consequence not surprisingly an increase in metabolic rate one thing that's interesting about mate is it causes a slight decrease in heart rate for reasons that still escape me there's a single study showing that heart rate is slightly reduced which is kind of nice because if when I drink too much caffeine my heart rate goes up maybe that would increase my fidgeting and my fat burning but I don't like the feeling of having my basal heart rate being up too high I like my heart rate elevate during exercise but not when I'm just kind of resting or working and throughout the day and for some reason that I don't understand there's an effective mate of increasing fat oxidation but reducing heart rate just slightly so that's interesting and it probably lends itself to my you're just explains the subjective experience that I've had of that mate is kind of a nice even mellow stimulant it's not this you know really supercharged stimulant like caffeine from coffee or other sources although if you drink too much mate you will also make you and there's one more compound that I think we should discuss in terms of increasing fat loss and that's carnitine or acetyl carnitine they lie in the same pathway we can return to our basic knowledge now of fat mobilization and oxidation after fat is mobilized and makes it into cells and needs to be oxidized so literally the burning of fat and conversion of it into energy that is accomplished and is facilitated by the presence of glucagon being elevated GLP increases that process and insulin being low we talked about some ways to manage insulin both in this episode and in previous episode acetyl carnitine and acetyl carnitine in particular facilitates fat oxidation it can help convert fatty acids into ATP and indeed supplementing l carnitine can increase fat loss that's been shown at what dosages well people ingest anywhere from 500 milligrams to 2 grams per day in divided doses typically some people who are really extreme are taking injectable l carnitine I've certainly not tried that I confess I have used it in pill form from time to time but in part because of the fat oxidation effects but also because of the other effects that it tends to have so in exploring the effects that they'll see the little carnitine has it has a huge variety of effects on cellar metabolism it can reduce ammonia in the blood that is actually quite strong effect it can reduce things like c-reactive protein which is you want c-reactive protein levels to be managed you do not want them too high can slightly reduce blood glucose it can slightly increase HDLC the good form of the blood lipid and slightly reduce overall cholesterol and as I mentioned it can slightly modify the pathway involving glucagon such that you get a considerable effect on a huge effect on fat oxidation so it can improve fat oxidation rates it has a number of other effects some of which I talked about during the month on hormones and that sort of thing it has strong effects on rates of pregnancy and sperm quality so clearly carnitine is doing lots of different things in lots of different cells it's impacting sperm motility there in a large number of studies supporting that slight reductions in blood pressure and has these interesting effects on reducing fatigue during exercise reducing inflammatory markers like interleukin six so it has a number of effects that on the whole are quote unquote positive or at least in the direction of things that you may want and I should emphasize may you certainly don't need a c-rele carnitine in order to lose fat but now that you understand the cellular process by which fat is mobilized and oxidized it should make sense that if alkaline is important for converting fatty acids into energy then supplementing alkaline make sense acetyl-alcarnitine is the type of alkaline or the form of alkaline I should say that is transported and utilized most easily by the body that's why sometimes we distinguish between alkaline and acetyl-alcarnitine so once again we've covered an enormous amount of material we've talked about the science of fat loss and in particular we've explored this topic from the perspective of the nervous system how neurons and in particular the release of things like adrenaline epinephrine can facilitate fat mobilization and oxidation we talked about neat fidgeting this non-exercise type movement that can greatly increase caloric burn and why that is we talked about shiver another form of non-exercise movement that can really increase both caloric expenditure due to the shiver due to the movement as well as increase thermogenesis the heating up of the body through things like brown fat and even the conversion of white fat to brown fat which is a good thing if you want to oxidize fat we talked about cold as a particular stimulus to induce shiver and how to use getting into and out of cold as a way to stimulate shiver and avoid cold adaptation so that you continue to oxidize and burn fat if that's your goal if you want to check out the protocols for that they're at the cold-plunge.com and in weeks to come we're going to be adding more protocols to that website not just for fat loss but for things like resilience reducing inflammation etc so be sure to check those out again those are totally cost free talk about exercise how rather than thinking about cardiovascular or weight training exercise that we should perhaps look through the lens of this adrenaline system and how it interacts with fat stores and think about low medium or high intensity exercise whether or not we show up to that fasted or not turns out showing up to that fasted can be useful if you start with high intensity movements and then move into lower intensity type exercise if you're going to go long duration it probably doesn't matter unless you're exercising longer than 90 minutes whether or not you eat or not we talked about caffeine as a stimulant and a stimulus for epinephrine and adrenaline release as a way to access more fat metabolism and we talked about compounds that come from things like urba mate and guayusa tea this GLP1 pathway that can trigger increased fat oxidation so much so that the pharmaceutical companies are now developing compounds specifically to increase GLP1 for treatment of diabetes and obesity but you can leverage the GLP1 pathway through the ingestion of things like mate or guayusa if that's of interest to you and then we talked about alkanitine and how alkanitine itself is critical for the fat oxidation within an individual cells the conversion of fatty acids to energy and why having your insulin low and things like alkanitine and glucagon levels high or sufficient at least to can facilitate the burning of fat, fat oxidation so we covered a lot of material that's a lot of protocols I realize and that didn't the little list I just gave right there didn't even begin to get into all the details and corners that we discussed I hope you found this conversation interesting both for sake of understanding fat loss and how to lose fat more quickly and to lose more of it if that's your goal as well as simply to understand the biology of fat metabolism from a different perspective from the perspective of the nervous system if you're enjoying this podcast and you're benefiting from the information that you're learning please subscribe on YouTube that really helps us a lot there's also a notifications button that you can hit that will notify you anytime we release new content we release new episodes every Monday but sometimes we release additional material in between so please do subscribe on YouTube as well if you could subscribe on apple and or Spotify that's terrific and really helps us and at apple you can give us a five star review if you think we deserve a five star review as well as you have the opportunity to give us feedback at apple the comment section on YouTube is the place to give us feedback whether or not you like an episode whether or not you don't like an episode aspects that you particularly liked suggestions for future content we do read I do read through all the comments it takes me some time I sometimes fall a little bit behind depending on other duties but I read all the comments and I do take them into account when developing this material and the structure of the material so please do provide feedback in the comment section we 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want to thank you for your time and attention today and thank you for your interest in science