

## Effects of Fasting & Time Restricted Eating on Fat Loss & Health | Huberman Lab Podcast #41

This episode I discuss the science and practice of fasting also called time-restricted feeding. I review the data on how limiting food intake to specific portions of every 24-hour cycle (or fasting longer) impacts weight loss, fat loss specifically, liver health, mental focus, muscle, longevity and more. I explain how "fasted" is contextual, and relates to blood glucose levels and their downstream effects, and how the depth of fasting can be adjusted with behaviors such as different types of exercise, or with glucose disposal agents. I also discuss the optimal fasting protocol: and both the absolute (non-negotiable) and variable (contextual) features of a fasting/time-restricted-feeding protocol that will allow you to get the most benefits. I also discuss what does and does not break a fast, the effects of fasting on hormones like testosterone and cortisol and on fertility. I also review how different feeding windows of 8 or 10 or 4 hours differentially impact the effects of fasting, and why the classic 8 hour feeding window came to be but also might be ideal. I discuss mechanisms and offer tools to discern the optimal fasting duration and timing for you.

#HubermanLab #Fasting #FatLoss

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[offbeat uplifting music] - 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. Today, we're talking all about fasting. And anytime we're talking about fasting, we are also talking about eating, because we all need to eat sooner or later. We're going to talk about how fasting and when we eat influences a large range of aspects of our health and wellbeing, both physical and mental. So, well, nowadays, most people are familiar with the term intermittent fasting, also sometimes called time-restricted feeding. I think most people don't really understand how that process works. It's sort of obvious that intermittent fasting, aka time-restricted feeding, involves eating at certain periods of each 24-hour cycle, or maybe even not eating for entire days, in some cases. But, if you think

about it, everybody sleeps eventually. And therefore, because people don't eat during their sleep, almost everybody is employing some form of intermittent fasting or time-restricted feeding. What we're going to talk about today is how particular schedules of time restricted feeding can impact our health in different ways. And when I say different ways, I mean, we're going to talk about how intermittent fasting, aka time-restricted feeding, impacts weight loss, fat loss in particular, muscle maintenance, and loss and gain, organ health, such as gut health and liver health, the genome, the epigenome, inflammation, sickness, recovery, and healing from sickness, exercise, cognition, mood, and lifespan. So we're going to cover a tremendous amount of information. I promise to make it all directly accessible, regardless of whether or not you have a background in biology and metabolic science or not. I'm also going to talk about a lot of tools. In fact, I'm going to discuss a number of tools during today's episode that actually make it such that you don't have to follow any feeding schedule, or fasting schedule, same thing if you think about it, in any absolutely strict regimented way, meaning if you were to only eat during an eight hour period of each day, most of the time, but then occasionally eat across a 12 hour period of the day, in theory, that could actually have pretty serious detrimental health effects. And yet, there are things that you can do to attenuate those negative effects. In fact, there are things that you can do and or take that can make it as if you did not eat at all. And so we'll discuss what those tools are. And in many cases, for sake of health, weight loss, and performance, making the body think that it did not eat at all can actually be quite beneficial. So today, we're going to cover mechanism and we're going to cover tools. Before we do that, I want to highlight a particular result that was published recently, because it serves as a useful backbone as we wade into the conversation about fasting. This is a study that was published in the journal *Cell Metabolism: A Cell Press Journal*, excellent journal. And the title of the paper is "Fasting Blood Glucose as a Predictor of Mortality: Lost in Translation". And I'll explain what the "Lost in Translation" part means in a moment. But the basic takeaway of this study, and I should mention that the first author of the study is Palliyaguru, PALLIYAGURU, guru, Palliyaguru, et al. The basic finding of the study is that in humans, higher blood glucose is associated with mortality. And in fact, if you look at blood glucose, resting blood glucose across the lifespan, what you find is as people age, resting blood glucose goes up. Now, this is very interesting, because for a long time it was thought that metabolism actually goes down as we age. And to some extent, that's true, but the reductions in metabolism are not nearly as robust as we once thought that they were across the

lifespan. However, unless there's something done to mitigate the increase in blood glucose associated with the aging, almost everybody experiences a gradual, but regular increase in resting blood glucose that predicts mortality. Now, the title, as I mentioned, is "Fasting Blood Glucose as a Predictor of Mortality: Lost in Translation". And the reason that they included "Lost in Translation" in the title is that what I just told you, that increases in resting blood glucose predict mortality, or are correlated with mortality, is true for human beings and for non-human primates, monkeys. But the opposite is true in mice. And so I thought it was important to use this study as an example of where it studies in mice often, but not always, translate to humans and to non-human primates. So today, I'm going to be careful to distinguish when a study was performed in mice versus in humans, because it seems that at least when discussing feeding, blood glucose and other aspects of diet as they relate to health and wellbeing, whether or not a study was performed in rodents or in humans can be very important. In this case, the results were directly 180 degrees opposite to one another. In other words, in mice, resting blood glucose went down, and was associated with mortality. So lower blood glucose associated with mortality. Whereas in humans, higher resting blood glucose was associated with mortality. And obviously, what we're mostly interested in is health and wellbeing of ourselves, of humans. I'm sure there are some people out there that are intensely concerned about the health and wellbeing of mice, which you could imagine a few rare contexts where that's important, but obviously most of us are interested in human health.

00:06:02 Sponsors: Roka, InsideTracker, Helix

So I'll be sure to emphasize when studies were performed in humans versus in mice. Before we begin, I'd like to emphasize that 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. In keeping with that theme, I'd like to thank the sponsors of today's podcast. Our first sponsor is ROKA. ROKA makes eyeglasses and sunglasses that are the absolute highest quality. I've spent a lifetime working on the visual system and how we see, and ROKA, which is a company developed by two all-American swimmers from Stanford has developed eyeglasses and sunglasses that take into account the science of vision, and they've produced an absolutely terrific product. That product involves glasses that, first

of all, are very lightweight. Second of all, can be worn when performing any activity. They really are performance eyeglasses and sunglasses. So whether or not you're sweating or running around, whether or not you're working, whether or not you're hiking, cycling, et cetera, you can wear them for essentially any activity. The nice thing is they also have a great aesthetic. So unlike a lot of other performance sunglasses and eyeglasses out there that can make people look more or less like cyborgs, ROKA eyeglasses and sunglasses look great, whether or not you're wearing them to dinner or at work, or whether or not you're headed out for a run or a cycle or something of that sort. As I mentioned before, they're extremely lightweight. They don't slip off. And that's true, regardless of what activity you're engaging in. If you'd like to try ROKA glasses, you can go to [ROKA.com](https://www.roka.com), that's [ROKA.com](https://www.roka.com) and enter the code HUBERMAN to save 20% off your first order. Today's podcast is also brought to us by InsideTracker. InsideTracker is a personalized nutrition platform that analyzes data from your blood and DNA to help you better understand your body and help you meet your health goals. I've long been a believer in getting regular blood work done, for the simple reason that many of the processes that are occurring in your body that impact your immediate and long-term health can only be assessed from a quality blood test. And nowadays, with the advent of modern DNA tests, you can also assess your genome and how that's impacting your immediate and long-term health. The problem with a lot of blood and DNA tests is you get information back, but you don't know what to do with that information. And InsideTracker has solved that problem. They have a very easy to use dashboard so that when you get your results back, it will tell you, for instance, if your levels of a particular metabolic factor or hormone are too high or too low, what you can do, what you can take, how you can change your nutrition in order to adjust those levels and get them where you want them to be. This is tremendously useful and takes all the guesswork out of what to do with biomarker information. If you'd like to try InsideTracker, you can go to [insidetracker.com/huberman](https://insidetracker.com/huberman) to get 25% off any of InsideTracker's plans, just use the code HUBERMAN at checkout. Today's episode is brought to us by Helix Sleep. Helix Sleep makes mattresses and pillows that are tailored to your unique sleep needs, and in doing so, provide the best sleep possible. I started sleeping on a Helix mattress about a year or so ago, and it is the best sleep that I've ever had. If you go to the Helix site, you take a brief two minute quiz, and that quiz asks you questions such as, do you tend to sleep on your stomach, your side, or your back? Do you tend to run hot or cold during the night? Maybe you don't know, and they match you to a particular mattress that's

ideal for your sleep needs. In my case, I matched to the so-called Dusk mattress. I've been sleeping on a Dusk mattress, and as I mentioned, it's absolutely terrific. Best sleep I've ever had. It's really key to get a mattress that's best suited to you. If you're interested in upgrading your mattress, you can go to [HelixSleep.com](https://HelixSleep.com), take that two minute quiz, and they'll match you to a customized mattress for you. And you'll get up to \$200 off any of your mattress orders, and you'll get two free pillows. If you're interested in Helix Sleep,

00:09:42 Neuroplasticity Protocols & Online Lecture <https://youtu.be/Oo7hQapFe3M>

you can go to [HelixSleep.com/huberman](https://HelixSleep.com/huberman), and you get up to \$200 off your mattress, and two free pillows. I'd like to point you toward a valuable resource that's also zero cost and is available now online. This is an event that was recorded. The event was held by Logitech, and I was fortunate enough to partake in this event. And the entire event was centered around how to be a more effective learner and teacher using the modern principles of neuroplasticity. So at the link in the caption for this episode, you can go to what was called the Rethink Education Event. And there, I gave a seminar of about 20 or 30 minutes describing the modern neuroscience of neuroplasticity, the nervous system's ability to change in response to experience. I focused mainly on human studies and how different structures and different things, and tools that one can implement in the classroom and outside of the classroom can lead to faster and more pervasive, longer lasting learning of motor skills, music skills, mathematical skills, language skills, et cetera, all based on quality peer reviewed research. So if you'd like to check that out, you can head to that link. You'll also see an example of some of those tools in action, in a music classroom of a phenomenal music teacher, Ben Edie, who's a teacher out in Pasadena, who has applied these tools, at least to my knowledge, for the first time ever. Of course, all the tools that are there are listed out in what I call a plasticity super protocol, and all those tools can be applied to learning and teaching in any format that you like. So check it out.

00:11:20 Feeding, Fasting, Performance

It's in the caption to this week's episode, and it will remain there, it's up on YouTube and I hope you enjoy it. Okay, so let's talk about feeding, fasting, health and performance. And I want to just establish a few foundational terms so that we're all on the same page.

First of all, rather than talk about fasting or time restricted feeding, I'm largely going to talk about time restricted feeding, but please understand that time restricted feeding is just one side of the coin that is a two-sided coin that includes fasting on the one hand, not eating, and time restricted feeding on the other hand, I may occasionally say fasting, but because fasting and eating establish different biological conditions in the body, time-restricted feeding is the term that I will use to describe the overall plan of restricting one's eating window as it's called to a particular phase of each 24 hour day, or in some cases two particular days within the week. Because as you'll soon learn, there are aspects of time restricted feeding, aka fasting, that involve eating every other day, or eating one way for five days and then fasting for two days, and so forth. So I'll be very precise about what I mean and why I mean it. But for the time being, I'm going to refer to time restricted feeding as a way to put an umbrella over this conversation. Second of all, I am going to emphasize a lot of biological mechanism. If you've listened to this podcast before, you know that I always begin with biological mechanism. I do describe tools of how to implement those mechanisms, but I wholeheartedly believe that knowing mechanisms and understanding how these processes work gives you tremendous flexibility and understanding, and control over the processes of your mental and physical health. Whereas if I were to just list off a menu of things to do and not to do, those will work, but those will not give you the kind of understanding that would allow you to navigate through life, through travel, through dinners out, through different exercise schedules, whether or not you're one age or another age, male, female, et cetera, I'm giving you mechanisms so that you can gain more control over the systems in your brain and body. Everything's timestamped, so if you want to jump to the to do's, you can certainly do that, but I encourage you to hang in there for the mechanism bit.

00:13:50 Calories-In, Calories-Out (CICO); Perfect Diets

I will make it all very clear because if you understand mechanism, you are in a true place of power and control over your biology. If ever there was a topic that is controversial, especially on the internet, it is that of diet and nutrition. So I'm wading into this with a smile and in eager anticipation of all the but but but this and but but but that, and wait, but this showed that. Here's the deal, we need to precisely define what it is that we're talking about when we talk about nutrition. I'm going to give you an example of a study that was published a few years ago, 2018, by a colleague of mine at Stanford, Chris



Gardner, he's a terrific professor of nutrition and has done a lot of important studies on how nutrition impacts different aspects of health. This is a large-scale study. It was published in JAMA, the Journal of the American Medical Association, one of the very top tier journals in the area of medicine, and certainly for a paper on nutrition to show up there meant that it had to meet an exceedingly high standard. This paper, where Chris is the first author, it's Gardner et al, 2018 JAMA, looked at weight loss in people following one particular diet versus another particular diet. And this was a 12 month weight loss study. So it was focused specifically on weight loss, although they looked at some other parameters as well. And the basic conclusion of the study was that there was no significant difference in weight change between people following a healthy, low fat diet versus a healthy, low carbohydrate diet with significantly more dietary fats in them. This caused a lot of ripples in the world of nutrition and nutritional science, and certainly in the general population, because anyone that understands diet and nutrition would immediately say, but wait, there are all sorts of different implications of eating one type of diet, say low carbohydrate, higher fats, versus a higher carbohydrate, lower fat diet. And indeed there are. This study was focused specifically on fat loss and on weight loss. So as we discuss time restricted feeding, we need to be very precise about what are the effects of time restricted feeding, and of eating in particular ways at particular times, we are going to emphasize again, whether or not the study was done in mice or in humans, in athletes, in men, in women, or both, but the study from Gardner and colleagues is a beautiful study, and really emphasizes that if one's main goal is simply to lose weight, then it really does not matter what one eats provided that the number of calories burned is higher than the number of calories ingested. However, anyone out there who understands a little bit of biology, or a lot of biology will agree that there are many factors that impact that calories burned part of the equation. Some of those are obvious. So for instance, amount of exercise, type of exercise, basal metabolic rate, how much energy one burns just sitting there. I've talked before on this podcast about NEIT, Non Exercise Induced Thermogenesis, where if people bounce around a lot and fidget a lot, they can burn anywhere from 800 to 2,000 calories per day. So their quote-unquote basal metabolic rate is actually much higher simply because they're fidgeters, whereas people who tend to be more stationary have a lower basal metabolic rate, on average. There's a great science to support this. Metabolic factors and hormones are also very important. Hormones, such as thyroid hormone and insulin and growth hormone, and the sex story to hormones, testosterone and estrogen, those levels will also profoundly influence the

calories out, the calories burned component of the calories in, calories out equation. So if out there on the internet or in listening to a particular podcast or speaker, somebody says, this is the ideal diet, or calories in, calories out does not matter, or calories in calories out is the only thing that matters. I think it's very important to understand that there are some foundational truths, such as calories in, calories out, but that of course, hormone factors and the context in which a given diet regimen is taking place are exceedingly important. A good example of this would be puberty at that time in life, sex steroid hormones are changing profoundly in the body as our growth hormone and other hormones. And much of caloric intake is directed towards protein synthesis, towards the production of muscle and bone and other tissues of the body. And that's because of changes in hormones that we call puberty. So, there's no way that we can drill into every aspect of a given feeding plan or feeding schedule that would allow us to tap into every aspect of the list that I read out before weight loss, fat loss, muscle organ, genome, epigenome, inflammation, exercise, cognition, mood, and lifespan. But today, we're going to be very precise about how time restricted feeding, it's very clear from both animal studies and human studies can have a very powerful and positive impact on everything from weight loss and fat loss to various health parameters. This is a beautiful literature that's emerged mostly in the last 10 or 15 years. And as we march into this literature, what you'll see is that there actually is a perfect diet for you on a given day. And that perfect diet for you on a given day is contextual, meaning it depends on what you did yesterday and what you're going to do tomorrow. So there is a perfect diet for you. And today, I'm going to arm you with the mechanisms and understanding that will allow you to define what that perfect diet is and will allow you to eat on a schedule

#### 00:19:48 Feeding-Induced Health Conditions

and to eat the things that are going to best serve your goals. So let's talk about eating and what happens when you eat, and let's talk about fasting, or not eating, and what happens when you fast. I did an entire episode on eating and metabolism, and hormones and other factors that impact appetite. We don't have time to go into all those details now, although you're welcome to listen to that episode as well, but we can briefly describe the overall conditions that are set in the body when we eat and when we don't eat. The key word here is conditions. If I can emphasize anything today, it's that what you eat and when you eat it set conditions in your body, and those conditions can be

very good for you, or very bad for you, depending on when you eat. In fact, when you eat is as important as what you eat. I'll repeat that, when you eat is as important as what you eat, at least as it relates to health parameters, in particular, liver health and mental health. Some simple rules about eating. First of all, when you eat, typically your blood glucose, your blood sugar, will go up. Also, insulin levels will go up. Insulin is a hormone that's involved in mobilizing glucose from the bloodstream. How much your glucose and insulin go up depends on what you eat and how much you eat. In general, simple sugars, including fructose from fruit, but also sucrose and glucose, and simple sugars will raise your insulin and blood glucose more than complex carbohydrates. Things like grains, and breads, and pastas, and so forth, and grains, and breads, and pastas, and so forth will raise your blood glucose more than fibrous carbohydrates, like lettuce, and broccoli, and things of that sort. Protein has a somewhat moderate or modest impact on insulin and glucose, and fat has the lowest impact on raising your blood glucose and blood insulin. So what you eat will impact how steep a rise in blood glucose and insulin takes place. And there are a number of factors that are related to your individual health that will also dictate how steep and how high that rise in glucose and insulin will be. For the time being, I'm leaving out people who have type one diabetes. These are people that don't manufacture their own insulin, and type two diabetes is essentially insulin insensitivity, lack of sensitivity to insulin, which leads to high blood glucose. But, when you eat, blood glucose goes up and when you don't eat, blood glucose and insulin go down. The longer it's been since your last meal, the lower, typically, your blood glucose and insulin will be. And the higher, things like GLP1, glucagon-like peptide 1, glucagon being a hormone that's also secreted when you are in a fasted state or a low blood glucose state. It's involved in mobilizing various energy sources from the body, including fat through what we call lipolysis, also using carbohydrates, and potentially even using muscle as a source of energy. So, that's kind of a fire hose of information about what happens when you eat and don't eat, but just think of it this way, blood sugar and insulin go up when you eat, they go down when you don't eat, and other hormones go up when you don't eat. So there are hormones associated with the fasted state, and there are hormones associated with the eating and having just eaten state. Now, the most important thing to understand is that, like everything in biology, this is a process that takes time. So insulin and glucose go up when we eat, and it takes some period of time for them to go down, even if we stop eating, they will remain up for some period of time, and then go back down, it takes time. This is very important, because if you look at the

scientific literature on fasting, on time-restricted feeding, it's absolutely clear that the health benefits, not just the weight loss benefits, but that the health benefits from time-restricted feeding, occur because certain conditions are met in the brain and body for a certain amount of time. And that gives us an anchor from which to view what eating is in terms of how it sets conditions in the body over time. And if that sounds overly analytic, I promise you, this is the simplest and best way to think about any eating schedule or any eating plan. So I think it's fair to say that in the field of nutrition, there are a few landmark studies that serve as really strong anchors for building our understanding of what to eat and what not to eat and when to eat, depending on our goals. The Gardner study that I mentioned earlier is one such study, in that it says if your goal is weight loss, it really does not matter what foods you consume, provided that you consume a sub-maintenance, caloric diet. However, I want to emphasize again, that sets aside issues of adherence, meaning how easy or hard it is to adhere to a given diet. Some people find it much easier to follow a high fat, low carbohydrate diet. Some people fall follow a different diet because it's much easier for them to follow. And some people are concerned with mental performance and athletic performance. So that study doesn't say there's a best diet, what it says is that what you consume is less important than the amount of food that you consume,

#### 00:25:33 Time Restricted Eating: When We Eat Is Vital

at least for sake of weight loss, not necessarily for sake of health. Now, the study that I'm going to refer to next is what I would consider the second major pillar of nutritional studies. This is a truly landmark study that was carried out by Satchin Panda, who is a professor at the Salk Institute of Biological Studies in San Diego, an absolutely phenomenal institution, and an absolutely phenomenal researcher. I've known Satchin for a number of years, and I want to emphasize that the current literature on intermittent fasting and time restricted feeding can largely be attributed to Satchin and the work that he's done. There are others involved too, of course. And of course, time-restricted feeding and fasting has a rich history that goes back many hundreds, if not thousands of years in different cultures and religions, but the science of time-restricted feeding can really mainly be attributed to the incredible work that Satchin has done. And I'm grateful to consider him a friend and a colleague, and we consulted at length in anticipation of this episode. I also hope to have him on as a guest in the future. The landmark paper

that came from Satchin's lab was published in 2012. This was a paper in mice that set the basis for studies in humans that came later. And the title of this paper is time-restricted feeding without reducing caloric intake, prevents metabolic diseases in mice fed a high fat diet. So the title tells us a lot. It says that what's varied in this study is not what these mice ate, it was when they ate it. And there were essentially four conditions in this study and the results are absolutely remarkable. So I'm going to walk you through the major results. What they did is they gave mice access to different types of food. There were four groups, one group of mice had access to just a normal mouse diet. It would not be a diet that you'd be very interested in. I confess I've actually tasted mouse chow. If you work with mice at all, you just have to do it. At least once it doesn't taste very good, it tastes like a very bland Graham cracker cookie. And I confessed that. I only had the tiniest little bit, but mice like that stuff. And if you allow them to eat that stuff, what's called ad libitum whenever they want, you just keep it in their food. 24 hours a day, they will eat sometimes, and then they won't eat it at other times, or in this case, they also had a condition where they gave them mouse chow in a time restricted way, just for a certain number of hours each day, but about eight hours, or they gave them a high-fat diet. That was a separate group, got a high-fat diet at any time they wanted. So this was kind of the carnival for mice because mice really like high fat, highly palatable foods. And so they got a lot of goodies and high-fat in their food. And then there was a fourth group that had access to the high fat diet as much as they wanted to eat, but only during a restricted time period of each 24 hour cycle, now mice are nocturnal. Humans are what we call diurnal, actually, we're not really diurnal we're crepuscular, which means that we're most active in the morning and in the evening, not so much in the afternoon, but nonetheless, everything I'm going to tell you is true also for humans. And we know this now from human studies, one of the most important things to take away from this study was that mice that ate a highly palatable high-fat diet, a great tasting diet, but only during a restricted feeding window of each 24 hour cycle maintained or lost weight over time, whereas mice that ingested the same diet, same amount of calories, but had access to those calories around the clock, gained weight, became obese and quite sick. And as an additional second point, the mice that restricted their feeding window to a particular portion of eight hours of every 24 hour cycle actually showed some improvement in important health markers. And what was even more incredible is that mice that only ate during a particular feeding window, also experienced some reversal of some prior negative health effects. So this study really lit up the world and got

people excited

#### 00:29:45 The Eight Hour Feeding Window

about time-restricted eating again. They use an eight hour feeding window. The story around that eight hour feeding window is kind of interesting though. Not many people know this because it wasn't included in the paper, and there was no reason to include it in the paper, not to out anybody, but it turns out that the reason they used an eight hour feeding window and not a nine hour or a 10 hour feeding window, is because studies of this sort are actually quite demanding to perform and require the constant presence of the graduate student, or post-doc there to ensure that the food is in the cages at particular times and not in the cages at other times. And mice are really good at hiding food. They'll even hide food in their jowls. And so there's a lot of work that has to be done to prepare for that eight hour feeding window. And to make sure after that eight hour feeding window, there's all the food has been removed from the cage and from the jowls of the mice and so forth. And it turns out that the significant other of the graduate student and or postdoc, I won't reveal who they were running. This study forbid their significant other, the scientist from being in the lab for periods of time, that were much longer than the 10 or 12 hours that were required in order to ensure this eight hour feeding window. So when we hear the eight hour feeding windows are holy, they are not holy and later, we are going to talk about how eating for a time that's restricted to eight hours versus 10 hours versus 12 hours. For instance, how that impacts various parameters like health parameters and weight loss, et cetera. But the eight hour feeding window was actually created because of a real world constraint on the research and the relationship with the researcher performing the research,

#### 00:31:26 Feeding Deep Into the Night Is Bad (In Humans)

not because there's anything holy about an eight hour feeding window, now an important point about when the feeding window falls within the 24 hour cycle, it is very important that the feeding window fall during the more active phase of one's day, so for humans, that's typically in the early part of the day or the later part of the day, but not at night, put very simply, there are a lot of data now pointing to the fact that eating during the nocturnal phase of the 24 hour cycle is very detrimental to one's health. In fact, when we

eat can either enhance our health or can diminish our health. When we see light can enhance our feelings of wellbeing or can diminish our feelings of wellbeing. I've talked many times before about this, on the human lab podcast, that during the daytime, you want to get as much sunlight and other types of bright light in your eyes as safely possible. And then you want to avoid light in the middle of the night. It has detrimental dopamine lowering effects can cause depression, cortisol increases, et cetera. So when you view light is as important as the light that you view. And when you eat is as important as what you eat, in this study, they saw something really interesting, which was that not only did restricting food to a particular phase of the 24 hour cycle benefit, things like lean body mass and fat loss and a number of health parameters that we'll talk about in a moment, but it also anchored all the gene systems of the body and provided a more regular stable so-called circadian rhythm or 24 hour rhythm, you may be surprised to learn that 80%, 80% of the genes in your body and brain are on a 24 hour schedule. That is they change their levels going from high to low and back to high again, across the 24 hour cycle. And when those genes are high at the appropriate times and low at the appropriate times, meaning their expression is high and low at the appropriate times. And therefore the proper RNAs and proteins are made because DNA codes for RNA, RNA is translated into proteins. When that happens, your health benefits, when those genes are not expressed at the right times when they're higher or low at the wrong times of each 24 hour cycle, that's when you get negative health effects. This study showed that when mice restrict their eating to an eight hour period within the most active phase of their 24 hour cycle, many of the genes that are associated with these so-called circadian clocks, these genes have names like PER, BMAL, CRY1, et cetera, those so-called clock genes underwent a very regular entrainment, a locking in to the proper 24 hour schedule. And while this was in mice, we now know that this also occurs in humans, I've said before on this podcast, and I'll say it again, that light, and when we view light is the primary way in which these genes and the clock systems of our body get organized or entrained, meaning matched to the outside light dark cycle. So viewing light early in the day and in the afternoon, and as much as possible all day, great, ideally that sunlight, avoiding light in the middle of the night is also great. It's great because it causes the increases in particular genes and the decreases in particular genes in every cell throughout your body at the appropriate times, the second most powerful timekeeper or zeitgeber, as it's called, is food, and when you eat, and in this study, the results they saw underscore this point, what they saw is that the peaks in these clock genes became

very regular. And the dips in these clock genes became very regular. And that led to a whole host of really important, positive health effects. Conversely, when mice ate, whenever they wanted across the 24 hour cycle, these clock genes became really out of whack and the negative health consequences were the downstream result of these changes in these clock genes. This is now also been shown to be true for humans. So if you want to be healthy, you want your organ health, your metabolic health to be in trained properly. One of the most important things you can do is to, if you lied at the appropriate times of each 24 hour schedule and to not view light at other times of that schedule and to eat at the appropriate time of each 24 hour day. Now, again, there are rare instances that we will discuss when skipping entire days or entire 24 hour cycles of eating can be beneficial. But for now we're talking about schedules of time restricted feeding involve a window of feeding that falls during your more active phase, so during the daytime, putting aside people that work shift work during the daytime is when you want to eat. And this eight hour feeding window provided a very strong reinforcing signal that combines with light to ensure that these genes are expressed at the appropriate times.

#### 00:36:33 Liver Health

The short takeaway from this is you probably want to think about and perhaps even engage in time, restricted feeding. So, as I mentioned earlier, when mice can eat around the clock, bad things happen. And one of the bad things that happens is that the liver suffers, the liver is involved in all sorts of things, production of important hormones and other factors related to metabolism. And when mice can eat around the clock, their livers got very sick, fatty deposits in the liver. Other factors in the liver essentially taken down the pathway of liver disease, the time restricted feeding, essentially reversed that or led in many cases to an even healthier liver conditions, and that's based on this study, but also additional studies also now in humans. So restricting your feeding to a particular window, every 24 hour cycle has clearly been shown now in mice and in humans to enhance liver health, which is wonderful. How does it do this, well, it happens because food intake, as I mentioned earlier, sets certain conditions in the body that lasts for a period of time. Anytime we eat, whether or not we are a mouse or a human, there's a period of time that's required for so-called digestion, but also gastric emptying and other processes related to breaking down that food and utilizing it. And that is an active



process. It requires energy. And that process of breaking down food involves certain cellular functions that if they're ongoing throughout the 24 hour cycle or even extended too far across the 24 hour cycle, meaning you're eating across a 14 or a 16 hour, an 18 hour window, that causes serious problems. And this is now been established because of the fact that it increases the expression of different proteins and genes in the body, as such as TNF alpha, IL-6, IL-1. what are all those things? They are pro-inflammatory markers. So the reason that the liver gets sick when you're eating too often is because inflammatory markers are increased. These inflammatory markers are not inherently bad, they're there for a reason, but they are there in order to respond to certain challenges, immune challenges, or the ingestion of food and the breakdown of food. But then in an ideal circumstance, they are reduced in the period in which there's no food present in the digestive tract or in which there's very little food present in the digestive tract. So by eating around the clock, you're making yourself sicker by eating at restricted periods of time, each 24 hours a day, you're actually making yourself healthier and you're activating certain processes that can positively impact both weight, either maintenance or loss of weight. We'll talk about weight gain a little later and positively impacting things like liver health. Also the expression of different things related to brown fat, the fat that increases your metabolism. We will return to this also a little bit later and blood glucose regulation, so the takeaway from this study, in fact, there are many takeaways from the study. It's so wonderful is that liver health, bile acid metabolism, energy expenditure inflammation,

#### 00:39:45 Time Restricted Feeding Protocol: Rules

liver metabolites, many, many aspects of our health are impacted by when we eat, not just what we eat, as we move forward, and we talk about intermittent fasting for eight hour windows, six hour windows, 12 hour windows for all sorts of different intents and purposes. I want to start to establish a foundational protocol that all of us, any of us can use in order to maximize your particular goals. There are some absolutes within this realm of time-restricted feeding. Here are a couple of absolutes that you would want to consider, first of all, it pays off in the metabolic sense and in the health sense and in the weight maintenance or loss sense to not ingest any food in the first hour after waking and potentially for longer, so I want to repeat that. One of the key pillars of intermittent fasting is that for the first hour after you wake up and potentially for longer to not ingest

any food, okay, the second major pillar that's well supported by research is that for the two and ideally three hours prior to bedtime, you also don't ingest any food or liquid calories for that matter. And we will talk about what it means to break a fast and whether or not certain liquids, even coffee and tea can break a fast, et cetera, in a few moments, but just as a foundation, it's very clear from the research in humans that not eating any food or ingesting any calories liquid or otherwise for the first 60 minutes after waking up each day. And for the two to three hours prior to your bedtime, that's ideal for the parameters that we've discussed earlier, all the different things like weight and liver health and

#### 00:41:35 When to Start & Stop Eating

metabolic health and so forth. The two most common questions about intermittent fasting are when is the ideal time for the eating window? Is it early in the day, the middle of the day or later in the day? And how long should that eating window be? Should it be eight hours? We already heard why the eight hour window was first established. It was because of these lab conditions and the conditions of the particular relationship of the graduate student involved, or should it be seven hours or six hours or 12 hours. It turns out that there's some general frameworks that we can follow in order to answer these questions. As we move into this portion of the discussion, I want to highlight a very important reference that just came out, literally came out last week in the journal *endocrinology reviews*. And the title of this review is time-restricted eating for the prevention and management of metabolic diseases. Although the data in this paper go well beyond metabolic diseases, this is a paper from Satchin Panda's lab. It's a very lengthy review with an enormous table that's beautifully organized that scripts out all the studies done in humans. Well over a hundred studies looking at time, restricted feeding in athletes, men, women, children, diabetes, no diabetes, et cetera, with detailed references and description of the outcomes. I've spent a lot of time with this review, even though it just came out recently and is an absolute goldmine resource. It is also the major resource for everything I'm about to tell you if you would like to delve deeper into the material. So let's deal with this first question of when is the ideal feeding window, and here again, we're thinking about a schedule of eating that involves eating at least once every 24 hours, not two day or three day or every other day fast. So it turns out that the answer to the question, when is it best to eat is actually best answered by thinking about

the other side of the coin, which is when is it best to fast? So, because we are fasting during sleep, it's very clear that it's best to extend the sleep-related fast either into the morning or to start it in the evening. Now this might seem kind of obvious, but it's actually not so obvious. You could place that feeding window early in the day, middle of the day or late in the day. Let's think about what happens when we sleep, when we sleep, our body undergoes a number of different processes in the brain and body in order to recover the cells and tissues. Many of you have probably heard of autophagic, which is essentially a cleaning up a gobbling up of dead cells and cells that are injured or sick. And this is a natural process that occurs, and it occurs mainly during sleep. Although not only during sleep, fasting of any kind does tend to enhance autophagy. It is not the only way to create autophagic conditions. Autophagic conditions can be created simply by following a sub caloric diet. And there are other things that one can do in order to trigger autophagy, but fasting does trigger autophagy. So when we're asleep, the bad cells are getting gobbled up and eaten. And the good cells also are undergoing certain repair mechanisms mainly related to, or at least governed by those circadian genes that we talked about earlier, those clock genes. So you're already fasting when you're asleep and how deep you are into that fast depends on how long it was since your last meal. So if you fast early in the day, and you've been asleep for 5, 6, 7, 8 hours, I would hope somewhere between six and eight hours for most people is going to be beneficial. When you wake up, I mentioned earlier that you don't want to eat for at least the first 60 minutes after waking, but were you to extend that fasting to say, 9:00 AM 10:00 AM, 11:00 AM or even 12 noon or later you are taking advantage of the deep, fast that you were in during sleep. And certainly toward the end of sleep, now,

00:45:38 Gastric Clearance, Linking Fasting to Sleep &

why do I say deep, fast? Well, because when we eat the clearance of that food from our gut and the processes in our cells and organs that are related to digestion, and the utilization of that food takes about five to six hours, so if you eat a meal and that meal lasts 10 minutes, 20 minutes or 30 minutes, or even an hour, and then you stop eating, you've stopped eating, but you are not fasting at that point. You can say you're fasting because you're no longer putting food into your digestive tract, but you're not in a fasted state. You are not under conditions of fasting, later, I'll talk about things that you can do to accelerate the transition into fasting. So one thing is certain, that you want your eating

window to be tacked or attached to your sleep based fasting in a way that makes it easier for you to get into the fasted state for a period of time. So we can view that point from the perspective of best, better and worst, okay? So if you are like most people and you sleep at night, you're waking up somewhere around 6:30, 7:00 AM, or maybe even 8:00 AM. Let's say you were to push your fasting window out, such that you started eating at noon, and then you stopped eating at 6:00 PM. Well, then you're not eating from 6:00 PM until let's say your bedtime is 10:00 PM, but from 6:00 PM to 10:00 PM, your body is not yet in a fasted state because you just ate. However, you're starting to taper into a fastest state before sleep and then all through sleep. And until the next morning and late morning, you are actually in a fasted state, now, most people find it very hard to only eat in the middle of the day, so while that's best, it's ideal for sake of the fasting related improvements in health, it is not ideal. And it's not very applicable to most work and family and social situations. Most people eat breakfast with others and, or eat dinner with others. Some people eat lunch with others, but in general, it's hard to restrict your feeding window to just the absolute middle of the day, but from a purely health perspective, in a very objective way, that would be the ideal situation. Let's imagine a different pattern of eating where the feeding window starts in the afternoon starts around two or even 3:00 PM. Some people don't have much trouble or they can train themselves to get their feeding window out to two or 3:00 PM, and then they won't eat until 10 or 11:00 PM. Right, if you do the math, you realize that that feeding window is still pretty short. It still constitutes what we would call intermittent fasting or time restricted feeding. But assuming that they go to bed around 11:00 PM or midnight, they are not actually fasted in sleep because for the first six hours or so of sleep, maybe five, but probably more like six hours of sleep, they're still digesting the food that they consumed a late in the night. It does appear beneficial to grab a hold of that sleep-related fast, meaning you don't want your feeding window to be too close to bedtime. And that's why we came up with this kind of foundational pillar that I discussed with such an earlier, which is at least no eating for the first hour after waking, but also no eating within two to three hours prior to bed. And because we all need to sleep and sleep is seemingly important for our health of all kinds. You want to prioritize sleep, but because we also have to eat, then you start to think about this and maybe it's not so good to push that feeding window too late in the day, because when you go to sleep, you're not actually capitalizing on the sleep related fasting. Now it's not just the case that it's easiest to fast while in sleep, although that's true because when we're asleep, typically

we're not hungry or looking for food or foraging for food or wanting food or trying to resist food. We're just sleeping. There is something special about the fasting that occurs during sleep, because it's associated with a number of processes that relate to the so-called lymphatic system, the movement of lymph like fluids and other fluids through the brain, and kind of sweeping out a garbage disposal, if you will, a clearing out of the metabolic debris and some of the autophagy that's associated with bad processes in the brain. So we could do a whole episode on this, but essentially during sleep, and in particular, during fasted states of sleep, we are undergoing a number of automatic seller processes that clear out debris from our brain enhance cognition, or at least offset dementia. This is now well-established as well as a number of the same processes occurring in the organs of our body. So what we're starting to see here is that there are a number of constraints on when you can eat, now, I would be remiss if I didn't acknowledge the social constraints and the real life constraints, some of us, because we want to eat with our family and because our family or our significant others eat around eight or 9:00 PM, and that's the only time we're together, You have to eat late in the day. And that certainly not a sin. I'm not saying that's good or bad, here we're trying to establish if you recall, best, better, and worst. So from both a practical and a health perspective and a purely objective view of how intermittent fasting works and can benefit us, starting to eat each day, somewhere around 10:00 AM or around noon, and then allowing a feeding window that goes until six or maybe 8:00 PM. That seems to me, at least based on the data and what I understand about typical cultures, where people eat in the daytime and in the evening, that seems to me like the kind of schedule that will allow you to get the most out of intermittent fasting, time-restricted feeding, but does not set you up to be really out of sync with the social rhythms in most cultures. If you think about it from the perspective of say a noon to eight feeding window, what you'll find is that you're able to eat lunch with others. If you like, or by yourself, you will be able to eat dinner at a reasonable hour, at least in most countries, in most cultures, eating dinner somewhere between 6:30 and 7:00 PM is typical. When you say a feeding window, that goes until eight. That doesn't mean sitting down to dinner at eight. That means your last bite of food or ingestion of any liquid calories was at 8:00 PM. Assuming that you go to bed somewhere between 10:00 PM and 1:00 AM that allows this tapering off, or this transition from feeding to a fasted state, and still allows you to capitalize on the special period of fasting that is sleep-related fasting. And again, I want to emphasize that the fasting that occurs during sleep is vital and eating too close to sleep will disrupt

## 00:52:35 Effects of Specific Categories of Food

that fasting related sleep. Now, there are a number of caveats and details related to this, and there's an important caveat in detail related to people that are specifically interested in increasing or maintaining muscle mass. So first let's talk about food volume and food type and how that relates to whether or not you quickly or slowly enter a fasted state. Because clearly when we talk about a feeding window, that feeding window could include any number of different foods, it could involve cake and ice cream, pizza, hamburgers, plants, fruit, whatever it is, or it could involve just fats or just proteins, et cetera. There are at least three factors that are going to govern how quickly you transition from ingesting food to a fasted state, remember, as you ingest your last bite or sip of calories, that's not when the fast begins. That might be when the fastening begins on your watch or on one of these apps that I'll refer to later, which can help you track your fasting and eating windows. But that's not when it actually begins because your body is still seeing food. You're actually carrying around food inside of you, even though you're not putting into your mouth, you're still eating in some sense. So it should be somewhat obvious that very large meals are going to take longer to digest than very small meals. So that will impact how slowly or quickly you migrate from a fed state to a fasted state. There's no way I can spell out what exact volume of food you should ingest based on the size of your stomach and et cetera, but you're all familiar with being extremely full, very full, comfortably full, somewhat full, or not feeling full and feeling hungry. So learning to gauge food volume is important. Also foods that include some fats or a lot of fats will tend to slow gastric emptying time. And depending on the kind of fats, it could mean that a given meal is digested within three hours versus five hours. And more fats might be a large meal with a lot of fats has been, can take five or six hours. A smaller meal with less fat is going to be digested more quickly consuming calories in liquid form is going to mean that gastric emptying time is going to be faster. And then of course, there's the glucose and the insulin aspect to it, which is that foods that lead to big steep rises in glucose like pure sugars. Then your glucose will drop, however, if they're combined with fats, then it tends to be a more gradual rise in glucose and it's more sustained, et cetera. Fibrous foods will also create a more long lasting sustained release in glucose. The important thing here is to establish a feeding window that you can comfortably manage, okay? Meaning that on average, you can obey a six hour

feeding window or an eight hour feeding window or a 10 hour feeding window. And then to place that feeding window in a social and life context that you can manage on a regular basis, now, there are two key points that have been gleaned from the

00:55:40 Precision In Fasting: Protocol Build

scientific data about this feeding window and when to place it. And this is based on a really important experiment that Satchin and his colleagues have been doing. There's a website that they have zero-cost website called My Circadian Clock, you can go to this website free of cost. There are a number of important resources there, but what they've done is they've examined the feeding behavior of thousands of people. People will take a picture of the food they're about to eat, and it enters into their account, maybe your account, if you create one on My Circadian Clock, and they do this over many days or weeks, what's great about this is it establishes what's essentially called a fetal gram a time in which people ate. And a number of important findings have emerged from these fetal grams, across large populations of people, different time zones with different schedules, et cetera. First of all, almost everybody underestimates their feeding window. Meaning people who think that they are on an eight hour feeding window or six hour feeding window, when their data are analyzed, it almost is always the case that they're actually on a feeding window that's one or even two hours longer than they think you think, well, how could that possibly be if people are taking their first bite at noon and they're taking their last bite at 8:00 PM? Well, that must mean that they are on that feeding window of eight hours. And it turns out that people cheat, but they don't cheat in any kind of obvious way. They might have, you know, a glass of wine after dinner, or they'll have a cup of tea and a little bite of a cookie. And so when people are honest and they are honest, in most cases for this experiment, what you find is that most people's eating window is actually quite a bit longer. So in discussing this with such in and reviewing the literature, it's clear that if you'd like to be on a 10 hour feeding window, that you should probably select an eight hour feeding window, because there's always a little bit of a taper on either side of that eating window. Very few people are extremely strict about these eating windows. It's just hard to do in the context of life events and social gatherings and, and family and so forth. Okay, so as we build forward, your ideal fasting slash time-restricted feeding schedule, we now have several different rules that we can list out first, at least no food for the first hour after waking up at least one hour, two, no

food intake for two and ideally three hours prior to your bedtime. Three, if you want to select an eight hour feeding window, then you should probably focus on a six or seven hour feeding window because in reality, your feeding window is going to be longer reality, meaning real life constraints. And if you'd like to be on a 10 hour feeding window, you should probably select an eight or a nine hour feeding window, because the way it plays out is that people almost always eat outside of their eating window, somewhat. The other nice thing about selecting a slightly shorter eating window than is comfortable for you is that it takes into account that as you take your last bite or your last sip of calories, there's this time or taper before, which you are actually in a fasted state. And because you're eating different things on different days, presumably some foods leave your gut more quickly. Some things spike your insulin and your glucose more than others. Sometimes you eat more fat, sometimes less fat. This allows you to fall well within the margins of the benefits of time-restricted feeding that had been demonstrated in humans, which generally involve an eight hour window or so. So I think this eight hour window or six hour window is a good thing to shoot for most people, some people, and we will discuss the exceptions, but some people truly are exceptions to this.

#### 00:59:30 4-6 Hour Feeding Windows

They just require more food. And along those lines, I just now briefly want to touch on some of the studies that have looked at using a very short feeding window of about four hours, nowadays, a number of people are doing the so-called one meal per day, or are restricting their feeding window to just four hours or six hours. And that turns out to be an interesting strategy and the data around it actually are a little bit surprising. One surprising thing to leap out of this massive literature review on time restricted feeding in humans is that relatively short feeding windows of say four to six hours do produce a number of positive health effects. Things like increased insulin sensitivity, which we know is good, remember type two diabetes is a reduction in insulin sensitivity improvements in beta cell function and the pancreas decreased blood pressure, decreased oxidative stress decreases in things like evening appetite. So positive health effects and psychological facts in general. However, they either produce no change in body weight, or they tend to produce even increases in body weight, now, of course there's variation between individuals and between studies, but this is somewhat surprising. So the eight hour feeding window seems to be very beneficial across almost



all the parameters that we've discussed, inflammation, weight, loss, fat loss, et cetera, and adherence. I should mention people's ability to stick to the diet seems quite good on this eight hour feeding windows, but when people try and undergo very short feeding windows of four to six hours, it seems that they are overeating in that four to six hours, at least overeating with respect to their metabolic needs. Now, the contrast to this is the so-called a one meal per day schedule, very few studies on one meal per day, one meal per day, unless it's a very, very long meal, a sort of feast typically would not last four to six hours because it sort of depends on how you define a meal. But when you look at the very few, I should emphasize, again, very few studies on one meal per day. People typically maintain or lose weight on the one meal per day schedule. So what we can say is that the seven to nine hour feeding window produces all of the major health benefits of time-restricted feeding as well as being pretty straightforward for most people to adhere to on a regular basis and on a regular basis, turns out to be very important. I'll get back to that point in a moment. Whereas the four to six hour eating window doesn't seem to serve people as well as say a seven or eight hour eating window, simply because people are overeating during that eating window and the one meal per day, while perhaps ideal for certain people's schedules may actually cause people to under-eat. And in some cases that might be what people want. They actually want to under-eat. But when we start thinking about in work and in sport, and when we start considering hormone health and hormone production, fertility, that's when we can really start to look at the seven to nine hour feeding window versus the four to six hour feeding window versus the one meal per day type feeding window with some different objectivity, we can start to look at it through a different lens because it turns out that when you place the feeding window and how long that feeding window is actually will impact a number of other things in particular hormones, that can be very important for a number of things related to sex and reproduction can be related to performance at work performance in athleticism.

#### 01:03:08 Protein Consumption & Timing for Muscle

And there are excellent studies on this. So let's explore those now. So let's talk about some conditions where having the feeding window early in the day would actually be very beneficial. There was a study that was published recently in Cell Reports, again, Cell Press Journal, excellent journal peer reviewed, very stringent, from Aoyama, et al, so this is AOYAMA, et al. This was published just recently in July, 2021 that looked at

the distribution of protein intake in different meals delivered either early in the day or later in the day. And I'm summarizing here quite a lot, but I should mention that this study was performed in both mice and humans, same paper, mice and humans and involved hypertrophy training, essentially increasing the weight bearing of given limbs to try and induce hypertrophy, which is the growth of muscle tissue. It does appear that muscle tissue is better able to undergo hypertrophy by virtue of the fact that there's better or enhanced protein synthesis early in the day, because of the expression of one of these particular clock genes called BMAL, BMAL, BMAL regulates a number of different protein synthesis pathways within muscle cells, such that eating protein early in the day, supports muscle tissue maintenance and or growth. And in this study, they also looked at the effects of supplementing so-called BCAs branch chain amino acids, which is popular in bodybuilding circles and in strength training circles and BCAs are essential components of a number of different foods, but can also be supplemented. The takeaway of this study is pretty straight forward. However, the takeaway is if your main interest is maintaining and, or building muscle, then it can be beneficial to ingest protein early in the day, you would still want to obey this, what we're calling a kind of foundational rule of no, not eating any food for the first hour post waking or at least the first hour post. And the cutoff for when you would want to eat protein would be sometime before 10:00 AM. And there I'm averaging across a number of different situations, but in general, this BMAL expression is such that let's say you wake up at 7:00 AM. Your main interest is in hypertrophy or maintenance of muscle. Then you would want to ingest some protein sometime before 10:00 AM. But obviously if you're interested in getting the health effects of intermittent fasting, that you wouldn't ingest any food for at least the first 60 minutes upon waking. Now it's not as if at 10:01 AM a gate slam shut and you can't generate hypertrophy, of course that's not the case. However, it's very interesting that it doesn't matter when the resistance training, the load bearing exercise occurs in the 24 hour cycle. So whether or not in other words, people are training early in the day or they're training late in the day. It still appears that ingesting protein early in the day favors hypertrophy or that one is better, or I should say more easily able to access hypertrophy by way of these clock, regulated protein synthesis mechanisms by ingesting protein early in the day, in no way, shape or form does this study say that ingesting protein later in the day is somehow bad for you? It just emphasizes the positive effects of ingesting protein early in the day for sake of muscle maintenance and or hypertrophy. So if you're somebody who is mainly concerned with muscle maintenance and hypertrophy,

then it may make sense to move that feeding window earlier in the day. And certainly there are people out there who are interested in muscle maintenance and hypertrophy, who aren't doing intermittent fasting at all, and that's also perfectly fine, but this just so happens to be an episode about intermittent fasting and time restricted feeding. There are of course, modes of eating where one eats small meals spread throughout the day or weights meals differently. Such that meals early in the day are larger than later in the day or vice versa. There are a near infinite number of ways to organize this. But if you are somebody who is interested in deriving, the many clearly established health effects of time-restricted feeding, and you are somebody who would like to maintain or build muscle, then ingesting proteins in the early part of the day would be important to you at least on the basis of these results. And therefore that eight hour window that we've established as more or less ideal shifted to the later part of the day might not be as beneficial for you. Now I can just personally say that for me. When I wake up in the morning, it's very easy for me to not eat until noon or one or 2:00 PM. Eating early in the day is actually somewhat of a challenge. I discuss this point with Satchin, because we were talking about how is it that one can move their feeding window or place themselves onto a different

#### 01:08:13 How to Shift Your Eating Window

schedule of intermittent fasting. And it's very clear that one needs to provide a transition period in order for that to happen, you should allow yourself a transition period of anywhere from one week to 10 days in which you shift your feeding window by about an hour each day or so. And then once you establish a feeding window that feels comfortable for you and that you think you can maintain over time, that you simply maintain that feeding schedule for at least 30 days, but ideally you would do that indefinitely. Now this turns out to be important based on data that they've gleaned from this My Circadian Clock massive experiment that they've been doing, where people are entering the times that they're feeding and, and eating. Excuse me, anytime we talk about mice, I always think about feeding because I come from a background in my lab, works on both laboratory mice and on humans. And anytime I think about humans, I think about eating, but of course they are the same thing. The interesting thing to emerge from that very large data set in humans is that when people log their feeding times, as I mentioned before, oftentimes they think they're eating in an eight hour

window, but they are actually eating in a much broader window. However, even for people that are very good about restricting their feeding to a four, six or eight hour window, if they're very strict about the start and stop times, and when they ingest calories, one of the findings that's really been important to note is that almost every individual has a lot of drift in when that eating window resides in their 24 hour period. In particular on the weekends, people are either extending or shifting their feeding window in a way that makes it seem that they've traveled to another time zone and are eating according to another time zone. And this is extremely important. As I mentioned earlier, based on the 2012 study from Satchin's lab, where eating at a particular phase of each 24 hour cycle can help enhance the expression of these clock genes. If you are eating within a very strict or semi strict feeding window, but that feeding window is migrating around from day to day or five days a week. You're really organized about when that falls, let's say for sake of example, from noon to 8:00 PM, noon to 8:00 PM, Monday Noonday PM, Tuesday, Wednesday, noon to 8:00 PM, Thursday and so forth. But then on the Saturday, it's becoming 11:00 AM and you're ending it early, or perhaps your starting early in the day on Sunday, you're having brunch that starts at nine 30 or 10, and then it's extending out still just eight hours. But it shifting around that can cause disruptions in the circadian clock mechanisms that cause disruptions in the downstream effects of eating that are taking at least two to three days to recover from. So obviously we don't want to be overly neurotic about this stuff, but because this is an episode about the science of intermittent fasting and time restricted feeding, as important as how long your feeding window is, is where that feeding window resides in each 24 hour cycle. And perhaps even more important than that is that it be fairly regular where that feeding window resides. Because even if you have a very short feeding window, if it's drifting around from day to day, that actually offsets a number of the positive health effects of intermittent fasting. So to really just underscore the way that these different pieces of the biological puzzle fit together, if you are very strict or semi strict about your eight hour feeding window, but on the weekends that eight hour feeding window is falling later than it normally would during the middle of the week. It is as if you are going to bed later, even if you're going to bed at the same time, at least from the perspective of metabolic health, because of the way that eating impacts these clock genes and impacts, or I should say subtracts, the sleep-related fasting that you would normally experience if you were to finish eating that a couple hours before bedtime, so again, we don't want to create any overly obsessive or neurotic focus on this, I think that most, all people could

benefit from a time-restricted feeding schedule, but they should really think hard about what they can stick to on a regular basis and understand that they tend to underestimate the feeding window, that they actually are partaking in, and that they should place that feeding window in a portion of the 24 hour cycle that they can be consistent on most days, and I want to emphasize most again, because we are not laboratory mice. We don't have a graduate student coming in for eight hours a day because that's what their significant other will allow them to do. And then removing the food from our jowls and from our cages, we have access to food pretty much, 24 hours a day, along those lines, however, there are things that we can all do that will allow us to offset some of the drift if you will, that we experience or that we induce in terms of when our feeding window occurs or that the feeding window might push

#### 01:13:20 Glucose Clearing, Exercise & Compounds

out a little later and then therefore start a little later, the next day, there are things that we can do in there, things that we can take. And so I'd like to discuss those briefly. So throughout this episode, I've more or less been alluding to the fact that when you eat, there's some period of time afterwards in which you're actually still eating, at least from the perspective of metabolism, because glucose is up, insulin is up and you're undergoing different metabolic and digestive processes that don't really speak to you being in a fasted state, right? It's not just about when you take your last bite or your last sip. However, there are things that we can do to accelerate the transition from a fed state to a fasted state. And so I'd like to discuss what those are. And I want to emphasize that the term fed state is probably a better way to think about it than eating or not eating because we think of eating the verb, we're eating, we're eating, okay, we're done eating I'm fasting now, but you're not actually fasting you because you are fed. So we should really think about fed and unfed states because from a seller processes perspective and from a health perspective, that's actually what your body and your system are paying attention to. And by now with everything that we've laid out, I think that should be intuitive to understand. So there's a fun and exciting concept related to this, which is glucose clearing. You may have heard the old adage that if you take a 20 or 30 minute walk after dinner, that it accelerates the rate at which you digest that food. And indeed it does, clearing out of glucose from your system can be accomplished through a number of different means, but light movement or exercise does increase

gastric emptying time, so for instance, if you were to eat a meal that ended at 8:00 PM, and then plop to the couch, watch TV, or get on your computer or go to sleep, it would be five or six hours until you have transitioned from a fed state to a fasted state. However, you can accelerate that considerably by taking a 20 or 30 minute just light walk, it doesn't have to be speed walking. It certainly doesn't have to be jogging, but just walking outside or moving around. So glucose clearing is an important aspect of the transition from the fed state to the fasted state. And just a light walk can allow you to do that, now, if you can't get outside, some people will go through the gymnastics, literally of doing things like air squats and pushups and things like that, and indeed, those will increase the expression of things like GLUT 4 and things that mobilize glucose into muscles and things of that sort, but, you know, under most conditions, most people aren't doing push-ups after dinner, or certainly who've had a big meal, just taking a light walk can be beneficial. In addition, you could consider doing intense exercise. Now you wouldn't necessarily want to do that immediately after eating. So let's take a look at what high-intensity training of any kind does to blood glucose, because in this case, it turns out that when you do high intensity training actually has opposite effects on blood glucose, depending on whether or not you do it early or later in the day. So a fairly recent study looked at so-called HIIT training, high intensity interval training, which of course can take many different forms. It can take the form of circuit training with weights. It can take the form of, you know, burpees and pushups and sprints and all sorts of different things. But high intensity interval training is typically training that gets people's heart rates up, you know, well above 70% of maximum and then brief periods of rest and then repeating and how long the high intensity interval training of course will also vary. There's there are a very brief, you know, six or 12 or 15 minute workouts. Some people can carry on with high intensity interval training for up to 45 or maybe even 60 minutes in extreme cases. But when you look at the studies that have explored high intensity interval training and its effect on blood glucose, there are a couple of studies that leap out, for instance, one that emphasized that blood glucose levels will actually increase if high intensity interval training is performed early in the day and will decrease if high intensity interval training is performed later in the day. Now the purpose for this exploration was not to explore clearance of blood glucose for sake of intermittent fasting. It was mainly focused on athletic performance and whether or not that was better early in the day or later in the day, et cetera. But we can extract some information from these studies that are beneficial for sake of understanding glucose clearing. If you have

ingested food throughout the afternoon and evening and late in the day, and you're thinking about going to sleep and you'd like to enter sleep in a way that is less fed and more fasted, then engaging in high-intensity interval training in the afternoon will lower or evening I should say, will lower blood glucose. And in that way will help you accelerate your transition into the fastest state provided you don't ingest something after the high intensity interval training. Now is the increase in blood glucose that occurs from high intensity interval training early in the day, is that detrimental, not necessarily. So that oftentimes is associated with the shuttling of nutrients to the muscles. They've just done a lot of hard work. So it's not that high intensity interval training should not be done early in the day, in fact, for many people, including myself training early in the day, just for the way that my psychology and biology works is always better for me than training later in the day. And the other important thing to mention is that high intensity interval training done late in the day can be beneficial from the perspective of glucose clearing, lowering blood glucose, and helping transition from the fed to the fasted state in preparation for sleep. However, if you're ingesting caffeine or anything to engage in that high intensity interval training in a way that prevents you from getting to sleep well, then it's going to be detrimental overall. So the reason I mentioned this is of course, because it's nice to know that light walks after dinner or any other meal for that matter or high intensity interval training provided it's done in the second half of the day can lower blood glucose and speed the transition from fed to fasted states. But I also mentioned it because what we are really trying to achieve when we partake in intermittent fasting so-called time-restricted feeding is what we're really trying to do is access unfed states or fasted states. It's not really about when you eat and what you do. It's about extending the duration of the fasting period as long as you can, in a way that's still compatible with your eating, right, not the other way around. And this gets back to this key feature of our biology, which is that what we eat when we eat, when we exercise, when we view light, it's about setting a context or a set of conditions in your brain and body. So it's not so much about the activities that you undergo. It's about the activities you undergo and their relationship to one another over time, and so in this way, it really beautifully highlights the way that your biology is interacting all the time light is setting. When you're going to be awakened, when you're going to be asleep, when you eat is going to be determining when you're going to be awakened, when you're going to be asleep. And when you eat is also going to be determining when you are able to clear out debris from your brain and body and repair the various cells and mechanisms of your body, when you're able to reduce those

inflammatory cytokines throughout your body. And this is really the beauty of time research and feeding, which is, it's not really about restricting your feeding. It's about accessing the beauty of the fasted state, now, there are other ways to clear out blood glucose that involve supplements or prescription drugs. These are so-called glucose disposal agents, glucose, disposal agents, such as Metformin, which is a prescription drug or berberine, which is an over the counter substance will lead to very dramatic reductions in blood glucose. And so they shift you from a fed to a fasted state. And I know many people who take berberine before eating meals that include a large number of carbohydrates, for instance, as a way to clear out glucose. Now I've tried berberine before. And what I can tell you is that if you take berberine, which by the way is very much like Metformin, its effects are almost identical to Metformin in fact, but it's much less expensive and it's over the counter. If you take berberine and you have not ingested carbohydrates, many people, including myself, experience a splitting headache, you become hypoglycemic because it is a glucose clearing agent. So if you're going to experiment with things like Metformin and or berberine or similar, you want to be very cautious that you're not clearing out blood glucose, that's already low. And the dose response for this varies tremendously from one individual to the next. And there's a strong circadian component. So if some people react very well to berberine early in the day, but find that later in the day, it provides extreme headaches for some people it's the opposite. So I caution you in exploring things like berberine and Metformin that you should expect to experience a number of physical and psychological effects that may work for you

#### 01:22:37 Blood Glucose: Monitoring, mTOR & Related Pathways

might be great for you, but might also not be great for you, nowadays, there are a number of commercially available, continuous glucose monitors, I've tried one of these, it involves putting what's essentially a patch with a little needle that goes into your skin, which is continuing continually, excuse me, monitoring your blood glucose. And you can look at it at an app on your phone, and you can learn a lot that way about how different foods impact the increases in decrease in blood glucose. If you're doing experiments with berberine or Metformin, you can see how those impact your blood glucose. You can see how exercise hit training or otherwise impacts blood glucose, excuse me again, it's very hard to assess blood glucose without a continuous blood glucose monitor, and if



you're not using one, you're mainly going to be relying on subjective things like, oh, I feel like I have low blood sugar, or I feel shaky. Like I have high blood sugar or shaky cause you have low blood sugar. So I have to say that glucose clearing agents that involve a walk or exercise moderate or intense are going to be a lot easier to titrate and adjust the levels of then things that you're going to take, where you have to adjust the dosage. And then once you ingest a certain dosage, you're along for the ride, at least until the effects of that particular compound wear off, it doesn't mean those things don't have utility. It doesn't mean people aren't using them because many people are, but they are potentially a very sharp blade that is a double sided blade. So I encourage you to approach those with caution. If you decide to at all, it's worth thinking about what the low blood glucose state is and why it's beneficial as well as why it might produce headaches. And in some cases can also adjust the effects of other hormones in the fasted state, a number of different proteins that are expressed in cells undergo changes in their expression. We talked about this earlier, when we are fasted, we tend to reduce the activity of a particular protein called MTOR mammalian target of rapamycin. MTOR is very active in cells while they are growing. So throughout development, it's also very active in cancers of various kinds. MTOR needs to be what's called phosphorylated. If you don't know what that means, don't worry about it. But phosphorylation is a manner in which certain proteins are altered so that they can actually be functional within cells, MTOR is associated with cell growth of all kinds healthy and unhealthy. When MTOR is phosphorylated, there's a marker called PS6 so phospho MTOR expressed as PM6. If this is all escaping you, don't worry about it. Phospho MTOR and PS6 are reduced by fasting. Now, this makes sense. If you think about it, because eating and growth are associated with each other, fasting is not necessarily anti-growth, but it is not pro growth, and when we fast, we see increases in cells of things like AMPK, the sirtuins, things like transcription factors like FOX-O, ATF and ketones or ketone bodies. You may have heard of the ketogenic diet. What's the point of all this biochemistry, it's not, you just blitz you with a bunch of cellular biology and biochemistry. It's to say that we have cell growth pathways involving MTOR and PSX, and we have cell repair and cell shrinkage processes that are associated with AMPK, the so-called sirtuins, which Dr. Davidson Claire from Harvard and others are famous for discovering and understanding things like AMPK, these two different divergent pathways of cell growth and cell breakdown and repair and by breakdown, I mean, actual clearance autophagy, and repair. Those can be triggered by being in either the fed or the fasted state. So one way I'd like you to think

about the fed state, not just eating, but having recently eaten or the fasted state, meaning high blood glucose and, or you've recently eat eaten, or are currently eating or drinking calories, is that when you eat or when you don't eat, when you're fed, when you're fasted, you are either promoting cellular growth of all kinds or you're promoting cellular repair and clearance of all kinds. And so, again, this is about setting conditions in the brain and body. It's not so much about when you eat food A or B, it leads to increases in MTOR, anytime you eat any food, doesn't matter if it's plant-based, animal-based fat, protein, carbohydrate, doesn't matter. You are biasing your system towards a biochemical state of cell growth. And any time you haven't eaten for a while or blood glucose is low, you're biasing your system toward a state of cell repair. And this is why people who do not suffer from any blood glucose regulation issues take things like berberine as glucose, disposal agents, or take Metformin. I'm not necessarily suggesting that you do that, but it's because those things mimic fasting. They create situations in the body that promote things like AMPKs, and sirtuins, and others to push your body and your system

#### 01:27:40 Gut Health: Fasting, Clock Genes and Microbiota

down a route of repair, even though you might have just eaten a meal an hour ago, along the lines of the health benefits of intermittent fasting, there are nice data showing improvements in the gut microbiome and in particular, in the treatment of irritable bowel syndrome and other forms of colitis in time, restricted feeding, meaning time-restricted feeding seems to be able to assist people with those conditions, following the general parameters that I discussed before eight hours and so forth. Why and how, well, by way of intermittent fasting, impacting the expression of these various clock genes, and because the clock genes impact the mucosal lining the mucus lining of the gut, it appears that intermittent fasting can reduce the amount of so-called lactobacillus that's present in the gut. And lactose bacillus is when in high levels is correlated with a number of different metabolic disorders. At the same time, time-restricted feeding seems to enhance the proliferation of some of the gut microbiota, like acetobacter and some of the other ones that promote healthy mucosal lining, and that promote better overall intestinal function. So these are pathways that have now been established, and it appears that intermittent fasting isn't just modulating these processes, but is actually having a direct effect on the mucosal lining in a way that favors a healthier gut microbiome. So it should

come as no surprise that many people who experience gut issues benefit from restricting their feeding

#### 01:29:15 Non-Alcoholic Fatty Liver

window to eight hours or so per every 24 hour period. The other very exciting finding about intermittent fasting is one of the major health issues these days is the proliferation of so-called non-alcoholic fatty liver disease, 30 years or so non-alcoholic fatty liver disease was exceedingly rare to see in the clinic, except in alcoholics, fatty deposits in the liver are bad. It is essentially liver disease. Nowadays children and adults are showing up with non-alcoholic fatty liver disease. Some of these people are obese, others are not, but it's a serious health concern. And it's growing in numbers all the time. A recent study that was published in Cell Reports Medicine just a couple of weeks ago, tested the hypothesis, whether or not the gut microbiome or so-called brown fat tissue is impacting the liver health. And in particular nonalcoholic fatty liver disease. The short takeaway from this study is that contrary to what was previously thought, the gut microbiome, while very important for a number of other processes in the body doesn't seem to be related to this non-alcoholic fatty liver disease. This is surprising to people or should be to those of you that have been following the gut microbiome literature, however, brown fat, which is a healthy fat that we have between our two scapulae and in our upper neck, it doesn't tend to be blubbery type fat pads, but it sits deep to the skin, but creates a thermogenic effect in the body that is helpful for reducing the amount of other fat, the type of fat that we're more typically used to thinking about and talking about white fat and pink fat that's subcutaneous fat around the abdomen and so forth. Brown fat seems to have a direct correlation with the lack of non-alcoholic fatty liver disease. What this study showed was that in people that have diminished concentrations of brown fat, there is a higher probability of having non-alcoholic fatty liver disease. Now the good news is brown fat stores can be increased. And again, this isn't going to create blubber of brown fat. This is going to create increased thermogenesis and actually make people leaner and brown fat has a number of other important positive effects. Now, this is interesting because cold exposure of anywhere from one to three minutes, two or four times per week, or maybe even 10 minutes, two to four times per week can increase brown fat stores. Also time-restricted feeding has now been tied to the density of brown fat store. So time-restricted feeding also seems to positively increase brown fat stores,

probably because of the way that brown fat stores relate to epinephrin and adrenaline, which tend to go up when we're fasted. What does this all mean? This means for sake of liver health and for sake of reducing, or maybe preventing, or even potentially,

01:32:00 Effects of Fasting on Hormones: Testosterone, Cortisol

I want to underline potentially reversing non-alcoholic fatty liver disease, time-restricted feeding also appears to be beneficial. Many people out there are interested in optimizing their hormones, and as we mentioned earlier, insulin is a hormone and time-restricted feeding seems to have very positive effects on overall insulin profiles and so forth, but anytime you mentioned hormones, people immediately seem to leap to the sex steroid hormones, testosterone, and estrogen, because indeed they have powerful effects, both in the short-term and the long-term in terms of our mental and physical health and performance. There's at least one study that's explored the effects of time, restricted eating on performance, athletic performance, immune function, and body composition. This was a study by Mauro, et al, that was performed on elite cyclists. So I want to point that out. I was a randomized control trial, but what's really nice about this study is that it explored a number of different hormonal parameters in people that were using time restricted eating, or that had a more extended eating window. And they tracked everything very carefully. And the amount of food they were eating was actually pretty considerable, 4,800 calories, so that's a lot of calories, but then again, they were very active and they've measured a number of different things related to VO2 max, et cetera, performance and overall performance at what they did cycling is not the point that I want to emphasize here. Although there were some positive effects on their performance related to time-restricted eating, the point I want to talk about relates to things that presumably relate to most, everybody, which are the effects on things like glucose, thyroid, hormone, testosterone, sex, hormone, binding globulin, which can bind up testosterone and prevent the so-called free form of testosterone, which is the one that has most of the actions in the brain and body. And the major takeaway from this study was that time-restricted feeding of the same amount of calories as the so-called control condition, okay, same calories, but either compact throughout the 24 hour cycle to an eight hour feeding window or allowing them to eat over a larger feeding window did lead to significant decreases in free testosterone. And I think a number of people will raise their eyebrows to that and think, oh, well then maybe time-restricted feeding is not for

me. There are a number of important considerations, of course, one is while they decrease in free testosterone was significant. It's also going to depend on where people start out. So if somebody has already lower modest levels of testosterone and it drops by 10 or 20%, that could lead them into a state of poor performance and wellbeing, whereas if somebody has higher testosterone, a decrease will necessarily do that. So it's important to take that into consideration. This is why I'm always such a fan of people doing their blood work and knowing what's going on under the hood for them, a very change in hormonal profile was cortisol. So-called stress, hormone cortisol, of course is also naturally released early in the day in a healthy way to wake you up and promote alertness, but you don't want its levels to be too high or to have peaks in cortisol late in the day, that's actually correlated with depression and a number of other untoured things. I would have thought that by restricting a feeding window to a particular time each day, that these hard training cyclists would have undergone increases in serum cortisol and in fact, the opposite was true. They had significant reductions in serum cortisol as a consequence of time, restricted feeding. I should mention there were significant reductions in serum cortisol also in the control group, but not to the same extent. And the two groups did differ significantly from one another. Now this is important because if you just look at one hormone testosterone, you'd say, okay, based on these data, time-restricted feeding is reducing testosterone levels significantly, even though the number of calories is quite high and is held constant across the study, but in fact, because cortisol is lower, it may mean that the effects of testosterone or the reduction in testosterone is offset. And that's because cortisol and testosterone are always in this somewhat of a dance in terms of cortisol, inhibiting the effects of testosterone largely and vice versa. So it is interesting and important to look at the total gallery of hormones. And they did look at a number of hormones. They looked at other inflammatory markers. Those were not increased. That's not surprising if you remember back to the 2012 Satchin Panda study this early pioneering study on time restricted feeding. They saw reductions in stress hormones and in inflammatory markers in time, restricted feeding mice. And here, this also seems to be the case in humans. So the takeaway is for sake of hormone health, time restricted feeding is compatible with quality hormone health, even in high-performing athletes, based on everything we know, and that we've discussed, I would not suggest that people restrict their feeding window to less than eight hours, especially if they're training hard on a regular basis. And it's not just athletes that should pay attention to this, when we are working very hard, when we are

psychologically stressed, when we are studying for exams, or we are in conflict with somebody on a regular basis, that creates a stress in the body that's very similar to that of physical training, the body and brain don't distinguish between physical stress and mental stress, it's all nervous system. Remember that it's just cortisol and adrenaline. There's no special hormone just for physical stress versus psychological stress, so again, in thinking about what sort of feeding window will be right for you, we arrive back at this eight hour time been that seems more or less flexible for most conditions, even high-performing elite athletes. And I would say just by logical extension, even for people that have a lot of stress in their life. And I personally wouldn't suggest that people who have a lot of stress in their life where the potential for stress in their life shorten their feeding window much shorter than eight hours, because then you would expect that you would start to increase some of the inflammatory markers. You would increase the stress hormones, and you would be decreasing things like testosterone and estrogen, some of the sex steroid hormones. So again, it's all about context and the eight hour window, it isn't holy, but seems to be a really useful guide to extract the great health benefits of which there are many in, of which we've discussed from intermittent fasting time, restricted feeding. And yet that it could still be compatible with decent social

#### 01:38:40 Fertility

schedules and for maintaining hormone health in keeping with this, for women that are trying to maintain ovulatory cycles or for couples that are trying to get pregnant. I think it's also important to not create a feeding window that's too short. The relationship between feeding and body fat stores and glucose and leptin and hormones is a well-established one. And we can summarize it very easily here, although I've done several episodes related to this previously on optimizing hormone health. But basically we undergo puberty when there's enough food and there's enough body fat that the body fat sends a signal to the brain called leptin. That's a hormone that comes from body fat signals to the brain to turn on puberty that's puberty, but even as adults for women that are menstruating, there needs to be sufficient leptin signaling to the brain in order to maintain ovulation because of the way that the brain communicates with the pituitary and the ovaries. Similarly for men fasting or extreme exercise plus fasting, we now know reduces testosterone it's impacts are not exactly clear, however, if you reduce food intake, either in total calories or in duration too much, you will suffer a drop in sperm

counts, fertility will drop. And this makes sense. The body is communicating to the brain, whether or not conditions are sufficient in the body to reproduce and to presumably, and hopefully support the health and wellbeing of those offspring. So there's a logical link between body fat and eating and how much food is available to you and how long it's available to you and the signals in the brain that allow for reproductive success. There are some data that pointed differences in the effects of intermittent fasting for males versus females. Those data right now only come from mice, that study was published by Satchin Panda recently, we still await the studies in humans. Some people do not do well on intermittent fasting either in terms of mood or hormone health. And so everyone needs to determine for themselves whether or not having a time restricted feeding window is good for them. How long that time-restricted feeding window should be. I think eight hours is kind of a nice minimum to adhere to based on everything that we've covered today. And for some people time-restricted feeding is not going to be compatible with hormone health, for them, for them eating more meals spread throughout the day, presumably smaller meals, same caloric intake is going to be more beneficial for their hormones. This is something that is going to be individual and is going to have to be determined on an individual basis. However, if you're going to try time restricted feeding, I do want to remind you that taking a period of three to seven or ideally 10 days to transition into it, not just going, flipping from eating to three meals a day that span from 6:00 AM to 10:00 PM and suddenly going to an eight hour feeding window, but rather winnowing down that feeding window about an hour or so per day is going to allow the hormone systems of your body, including leptin the hypocretin orexin system, which are systems within the body, that signal to the brain, that food is about to come allowing those systems to adjust so that you're not overwhelmingly hungry, irritable,

#### 01:41:50 8-Hour Feeding Window: Weight Loss Without Calorie Counting

and you're not throwing your whole hormone system out of whack. I keep coming back to this eight hour feeding window, and I want to provide a little more basis for it. And just to encourage that it's not completely arbitrary. The lengthy review that I mentioned earlier, features a number of studies that have used this eight hour feeding window, but there's a particular study that I'd like to highlight mainly because I don't expect people to delve into the full reference list of the other review. And this is a study that was carried out between Satchi Panda's lab and Krista Varady's labs. This is a collaboration. The

study was carried out in humans and is entitled effects of eight hour time restricted feeding on body weight and metabolic disease, risk factors in obese adults, excuse me. And this study essentially showed, I'll just read the conclusions that an eight hour time restricted feeding produces a mild caloric restriction and weight loss without calorie counting, so that's key, right? These people aren't calorie counting somehow just by adhering to an eight hour window. They are taking in fewer calories than they're burning off and clinically it reduced blood pressure. So I mentioned the study, not because there aren't many others involving the eight hour feeding window also in humans, but because the eight hour feeding window has been tested in obese adults and non obese adults. And there are even a few studies in children. So this eight hour window seems to be a really good rule of

#### 01:43:20 Eating Every-Other-Day

thumb and a kind of anchor around which we can each think about incorporating time restricted feeding. There are of course, other patterns of feeding. And while some people have engaged in longer fasts of 24 hours, 36 hours or more alternate day fasting, meaning eating one day, not eating the next day or in some cases eating one day and eating very few calories, 500 or 600 calories the next day has been tested. A few studies have also looked at eating a sort of maintenance level of calories for five days, and then taking two days and fast clear through, or eating very few calories, you know, 300 or 500 calories. In fact, there's a sort of a community online of people that are exploring longer, fast for sake of trying to offset dementia or reverse effects of dementia, thus far, at least in my awareness, there isn't any quality clinical peer reviewed study on that yet for sake of dementia, although I await those studies, and if anyone's aware of them, please send me a link in the comments. But alternate day fasting has gotten the so-called safe bill of health. This has been written up meaning that people didn't suffer bone loss, they didn't suffer any major detrimental effects. It does seem that it can create significant weight loss and can help with obese individuals that it can reduce resting blood glucose, and every other day fasting in many cases can produce more rapid effects on weight loss and reductions in blood glucose than time restricted feeding, however, every other day type fasting for most people is not going to be feasible. They're just not going to be able to do that for a long period of time. And what hasn't really been done is the follow-up to see whether or not people who do every other day fasting or five days of eating followed



by two days of fasting, whether or not that leads to a rebound in weight gain, whether or not that leads to a rebound in blood glucose, et cetera. So for now the eight hour feeding window and time restricted feeding seems to be the most tested, supported in animal studies and in human studies and the one

01:45:29 Adherence

around which I think most people should orient if they're considering getting into time-restricted feeding, it's also sort of hard to imagine how one could include a significant exercise schedule or work schedule on every other day fasting. Remember, in any study, people are often being compensated, or at least are incentivized in some way to adhere to the study. This is one of the major issues that I have with any study that says that three or four different diets are essentially equal in terms of their ability to produce weight loss. Adherence is very different in the outside world where you don't have a researcher monitoring you where you're not logging all your food. Most people don't do that consistently. And we can take a little bit of a neuroscience perspective on this to try and arrive at what the best kind of organization of an eating plan, or if we wanted to call it a diet, we could would be for you. Many people find it easier to just not eat for certain periods of each 24 hour cycle than to eat smaller portions, portion control is very hard for some people, for other people it's manageable, but people like me. I don't eat half the croissant. I don't think it's a real thing, it's not, it's not available to me, I should say. Now, of course I could eat just half a croissant, but I noticed that when I eat the croissant, because they're so delicious that it creates a rise in blood glucose a rise in the other hormones and chemicals that are associated with ingesting delicious, highly palatable food. And it's actually a lot of work for me to just eat half the croissant. There's something that's much more thoroughly satisfying about eating the entire croissant. And actually there's something that somewhat satisfying about not eating the croissant at all. And just knowing that later I can eat the whole croissant. Now that's me.

01:47:15 Mental Focus & Clarity

Other people find that they don't have any trouble with portion control that for them just eating small bits of food throughout the day is what sets them in the right psychological and physical state for sake of work, et cetera. And I mentioned work and mental focus

because one of the aspects of fasting that have drawn a lot of people to time restricted feeding and fasting is the clarity of mind that people get. When first of all, they don't have to think about when they're going to eat because they know when their eating window begins. They also don't have to think about regulating their behavior because they already know when they're going to eat and when they're not going to eat. Whereas when you're restricting portions, you actually have to make decisions all the while. You know, and I think I like many people decide, well, you know, is that exactly half? Or could I have like another wrong on the croissant? This kind of thing. I don't negotiate with food. That's why I like a time restricted feeding window. I know I'm going to eat for, in my case, I use a 10 hour feeding window or so, and I'll eat the whole croissant. I just don't have to think about it, now, the food choices that you make inside of that feeding window are of course also going to be very important. Certain foods will increase blood glucose, such that you're going to get hungrier and hungrier. Others will maintain lower blood glucose and will allow you to be more controlled in the foods that you pursue. Those are all individual considerations that are deserving of their own entire episode. But I do want to point out that the advantage of time restricted feeding is that it involves a lot of the decision-making in the brain. The so-called go no-go circuitries of our basal ganglia, if you want to know this areas that control them. Anytime we have to restrict a behavior, that's called a no-go. Anytime we engage in a behavior, that's a go, no go behaviors require a lot of what's called top-down control, and it's very metabolically demanding. And so time restricted feeding allows you to depart from the whole no-go go negotiation that you have to undergo when you have to restrict portions. And so I think this is a reason why many people have

#### 01:49:12 Enhancing Weight Loss from Body Fat: Hepatic Lipase

gravitated towards time restricted feeding and why for people that don't want to have to think about all that it's just very straight forward. One of the more hot button issues out there is whether or not given equal amounts of caloric intake and equal amounts of activity and equal amounts of nutrients, et cetera, whether or not restricting food to a particular window biases, more weight loss toward fat loss versus loss of other tissues, because of course, when we lose weight, we can lose that from any number of different storage sites within the body, muscle water, glycogen, or fat. Now this is such a hot button issue that I almost don't want to get into it, but I'm going to get into it anyway,

because there are data that are very interesting. This is covered in the review that I mentioned earlier, that describes how if people follow a time-restricted feeding schedule for long periods of time. So 60 days or longer, there's some metabolic changes in the way that people metabolize energy that do seem to shift the system toward more fat loss relative to burning of other tissues when in a state of caloric restriction. And I want to say when in a state of caloric restriction, because there's really no way to cheat the system, there's no way that you can ingest far more calories than you burn or excrete, when I say excrete, you know, I certainly don't suggest this, but there, you know, bulimics and other people that have eating disorders will use laxatives as a way to eliminate food quickly from their system so it can't be converted into fat or other forms of energy. That's a very, in that case, it's a pathological situation, but in general calories in versus calories out, as I mentioned earlier as this kind of foundational element, but in states of caloric restriction, meaning sub maintenance intake, time-restricted feeding does seem to buy us more of the energy burned to compensate for that deficit from fat and the way it accomplishes it is very interesting. It turns out that it drives more fat loss by way of increasing a hepatic lipase. This is something called LAPC hepatic means of the liver and lipase, which anytime you hear ASC is means it's an enzyme. So it seems to increase hepatic lipase. So it increases the enzyme that metabolizes fat for lipolysis and energy production and reduces something called CIDEC, CIDEC. which is a lipid droplet associated and lipolysis inhibitor. Now that's a mouthful, no pun intended, but what CIDEC really is this lipid droplet associated molecule is it can inhibit lipolysis. So extended periods of time, restricted feeding, meaning eight hour feeding window or 10 hour feeding window that's obeyed for several months or more seems to allow the system to shift toward burning more fat or rather using a higher percentage of fat when in a caloric deficit. Now I doubt that this is going to resolve the truly barbed wire, almost hairball, ridiculous online debates about whether or not time-restricted feeding is better than another feeding schedule, look, I don't think any particular feeding schedule is holy. If you are sub caloric, meaning fewer calories burned than calories ingested, you're going to lose weight. But the data seemed to point to the fact that if you do time restricted feeding for a fairly long duration of time, and you maintain that, that you are increasing these lipases that increase lipolysis energy use from fat, and you're decreasing the lipid droplet associated lipolysis inhibitors. So it's both a you're removing the break and you're pressing on the accelerator of fat loss. I think that this logically points to a case in which using time restricted feeding with a sub caloric intake seems to

be at least to my mind, the most scientifically supported way to ensure that a

#### 01:53:15 What Breaks a Fast? Rules & Context

significant portion of the weight that one loses is from body fat stores. Any discussion about fasting would be incomplete without a discussion about what does and does not break a fast. However, there is no black and white answer to that question, and you should immediately understand why it's because eating and not eating are not equivalent to fed and fasted. It depends on when you ate how much you ate and where you are in your circadian cycle. We can actually arrive at a simple answer to whether or not something breaks the fast or not. Now the technical way to go about this would be to wear a continuous glucose monitor and to ingest little bits of food, of different kinds or large amounts of food, of different kinds and measure blood glucose, because ultimately blood glucose is the readout of whether or not your system is in a fed or fasted state. There are other parameters too, of course, but that's the dominant one in so far as the scientific literature says drinking water will not break your fast drinking tea will not break your fast drinking coffee, provided it as black coffee will not break your fast ingesting caffeine in pill form will not break your fast. There are other things that won't break your fast. For instance, eating one peanut when deep in a fasted state will not break your fast, eating a whole handful of peanuts might not even break your fast if you are in a very low glucose state. However, if you just finished a meal that included carbohydrates, or it was a very large meal of any kind an hour ago, yes, indeed, eating one peanut could break your fast. So it's all contextual, that's what's really important to understand, unless you're going to wear a continuous glucose monitor. And unless you are going to wear a continuous glucose monitor and set an absolute numerical threshold for what it is to break your fast. I think there are some simple rules that we can follow. First of all, anything that involves sugar in particular, simple sugars can potentially break your fast. And there's actually a study on this, which shows that if people ingest even one, one gram of sugar post dinner, if they had a full meal for dinner that can actually disrupt the expression of some of the circadian genes related to fasting and to sleep and sleep related fasting. Now that's pretty extreme, almost kind of scary to think about, but that's how sensitive our system is. If we already have somewhat elevated blood glucose from a meal that we ate an hour or so ago, whereas if we have run for an hour or train hard, high intensity training, and we haven't quite reached the beginning of our so-called

feeding window, will eating a small amount of food take us out of that fast? Well, depends on what the food is. If it's mostly fat, probably not, a number of people out there nowadays talk about so-called fat fasting, fat fasting as a way to kind of regal past the stringency of either eating or not eating as a black and white rule for feeding window versus non feeding window. So some people will ingest medium chain triglycerides so-called MCTs, or people will ingest fats only until their official feeding window begins. So these are sort of how the negotiations that people carry out tend to go. But that of course won't increase blood glucose and insulin as much as carbohydrates will, protein will have sort of an intermediate effect. And as I mentioned earlier, ingesting carbohydrates with some fat will tend to blunt the rise in glucose and will extend the duration over which glucose is released. So we really can't say food X or beverage X breaks a fast, however, at the extremes, we can say that, for instance, if you drink a can of soda pop, unless you just ran an ultra marathon, you're breaking your fast, okay, eat a piece of pizza, You're breaking your fast, you eat purely fats, maybe, probably not. If you've been fasting for five hours or more strictly fasting for five hours or more. So you can start to see where there's a lot of wiggle room and it's very contextual. And this is why any posts that you see or any information that you see that something does or does not break your fast, that doesn't place it in the context of when the last time you ate and what you ate and your activity and your time within the circadian clock schedule of 24 hours, it's a sort of meaningless discussion, so in general, I think what's really useful if you're not going to wear a continuous glucose monitor is to try and be fairly strict about when you initiate your feeding window and when you stop your feeding window and as time evolves and you establish a more regular routine of eating certain kinds of foods and not others that are right for you because as I've emphasized before on this podcast, and I will continue to emphasize keto works great for some people, vegetarian keto works great for some people, carnivore diet works great for other people. Some people are omnivores, some people are carnivores, some people are vegan. All of that is great and fine by me. Everyone has to establish what's right for them, today, we've really bypass the discussion about foods of a particular origin or type animal-based or plant-based. But all the same rules apply within this thing that we're called intermittent fasting or time restricted feeding. So what breaks a fast will depend and what you want to eat

01:58:50 Artificial Sweeteners, Plant-Based Sweeteners

or what you are willing to eat. That's a totally separate manner from when you eat. But as we've established, when you eat is vitally important, some of you are probably wondering whether or not artificial sweeteners or non artificial plant-based sweeteners like Stevia break a fast, this will vary somewhat. And I have to say the data on this are somewhat mixed. There is evidence that when people ingest artificial sweeteners, that it can create a transient increase in blood glucose followed by a transient decrease in blood glucose below baseline. This is thought to explain the increase in hunger caused by ingestion of things like aspartame and sucralose and things of that sort. There are not a lot of good studies exploring the plant-based non sugar sweeteners, things like Stevia, even things like monk fruit, which is a separate category unto itself. There aren't a lot of studies on this. I think most people need to establish this for themselves. The best way of course, would be to wear a continuous glucose monitor to go into a fasted state of either one hour or two hours, or maybe you've been fasting all night and then ingest Stevia in whatever form you want or coffee in whatever form you want with sucralose or aspartame, et cetera, setting aside the discussion about the effects of these things on the gut microbiome, which is a different topic entirely. I think it's fair to say that in moderation, the plant-based non sugar sweeteners like Stevia in particular, Stevia seemed to have a minimal impact on overall blood glucose when considered over a fairly large time been aspartame, and sucralose, saccharin. I think we can say more or less the same, but as soon as you get into a discussion about those, you also have to get into a discussion about some of the evidence published in nature and other excellent journals now pointing to the fact that when consumed in excess, not when consumed in moderation, but when consumed in excess that those might have some detrimental effects on the gut microbiome. So do artificial sweeteners break a fast? It depends on the amount depends on the type. And in general, I think you're probably okay provided that you're not indulging in them too often, however, some people just by virtue of tasting something sweet, feel a spike in their appetite that makes it harder for them to adhere to the feeding window. And so this is why you can imagine that a really well controlled study on this would be very hard to carry out. And I'm not really sure that it's worth our tax dollars to actually design and carry out a study like that because there would be so much individual variation in terms of discipline in adhering to the feeding window, whether or not people experience increases and drops in blood glucose, how that impacts them, whether or not they're exercising. It just becomes an infinite variable space, as we say, in experimental science. So you really have to determine that for you,

but I don't think that we can fairly say that artificial sweeteners break a fast.

02:01:42 Glucose Clearing II, Cinnamon, Acidity, Salt

I think that would be incorrect to say earlier, we were talking about glucose disposal agents, both behavioral and compound based things like Metformin and berberine, and in fact, cinnamon is even a mild glucose disposal agent. It can actually reduce blood glucose, lemon and lime juice, believe it or not, can lower blood glucose. You may have experienced this before of eating something very, very sweet and almost feeling kind of overwhelming or a poisoned by how sweet it is, especially if you're not accustomed to eating a lot of sugary things. One quick remedy for that is actually a half lime or half lemon squeezed into juice and drinking that just by virtue of the taste and by virtue of the fact that it will reduce blood glucose. You'll notice that that effect almost immediately disappears, that's not magic. That's the effects of acidity on blood glucose levels. So there are a number of things that can adjust blood glucose, they're not necessarily disposal agents, they're not sweeping it out of the bloodstream in the same way that berberine or Metformin would, or that high intensity exercise at the appropriate times of day would. But there is one particular thing that one can ingest that can help manage psychologically and performance wise through the fasting portion of the intermittent fasting and get you to your feeding window. And that's salt. I've talked a little bit about this on the podcast before, but because neurons use salt, sodium and potassium and magnesium, the so-called electrolytes in order to perform their magic of chemical and electrical signaling, everything you do depends on chemical, electrical signaling and all that chemical and electrical signaling requires electrolytes in some form or another neurons run on the passage of ions like sodium in and out of their cell membranes are, I should say, across their cell membranes to be accurate. Many people find that the kind of lightheadedness, the shakiness that's accustomed with having slightly low blood sugar can be offset by taking a half teaspoon or so of sea salt, or even just a tiny pinch of salt and putting into some water and drinking it. Some people find because of the glucose lowering effects of acidity, that if they're feeling kind of shaky and not well, and they put some lemon juice into water and drink that it drops their blood glucose further. So there's a common practice nowadays that's discussed on the internet of waking up drinking some water with some lime or lemon juice in it with a little pinch of salt. I think that little pinch of salt is a good idea. What is it doing, how is it offsetting all this? Well, salt water

actually has a mild effect as a glucose disposal agent, but it has a stabilizing effect on blood volume. And so, because sodium brings with it water and the so-called osmolarity of your blood in your body depends on the salt levels in your blood and brain and body. Many people find that they're feeling shaky. They're feeling lightheaded. They can't concentrate. They think they need sugar or food, but what will actually remedy that is some salt. And I know a number of people that have incorporated this practice and have written to me and saying, oh, you know, if I just take a little bit of salt in some water, they may or may not include the lemon or lime juice. They immediately feel better and find that it's actually quite straightforward to get out to that, to wait until the feeding window kicks in. This is especially true for people that are using caffeine because when you ingest caffeine, you actually excrete a lot of water, it has a diarrhetic effect. And with that water goes salt. So it actually causes you to excrete sodium. Now the role of sodium in blood pressure and hypertension is, you know, quite controversial science magazine, one of the premier scientific journals out there had a special issue all about salt some years ago, talking about the research around hypertension, indeed people with chronic hypertension or high blood pressure or very high blood pressure in particular should be wary of ingesting too much sodium. But for most people ingesting sodium provided they drink enough water and they don't have chronic hypertension or high blood pressure is actually beneficial. Now that doesn't mean you should be drinking seawater doesn't mean you should be overindulging in salt, but many people find that they can manage their mental and physical state and even feel really terrific, real clarity of mind, and really enjoy their fast when they're ingesting sufficient salt. And all it requires really is a small pinch of salt, ideally Himalayan or sea salt. If you want to get fancy about it, but table salt would be fine. And just drinking that in some water, maybe with lemon or lime juice to offset the taste a little bit can really stabilize one's jitters and can stabilize the mind, and you might also notice can offset that churning and yearning and appetite where you can't imagine going another five minutes before eating something suddenly you feel okay. And that has to do with a lot of the effects of blood volume caused by ingesting salt in the appropriate amounts. In other words, sometimes you think you need food,

02:06:42 My Circadian Clock, Zero-App

but what you really need to salt and salt can make you feel better immediately. I'd like to mention too excellent zero cost resources. If you're going to explore time restricted



feeding, or maybe if you already are doing time restricted feeding, I have no affiliation to either of these. The first is the website that I mentioned before, My Circadian Clock, which is the website hosted by Satchin Panda and colleagues. There are a lot of resources there where you can log your food intake, get information about time-restricted feeding all the science, the ongoing studies, et cetera. The other is the so-called Zero app. That makes it very easy to mark when you're beginning your feeding window and when you're ending your feeding window and in, so doing marking when you are beginning your fast and ending or fast, where at least initiating the beginning of the unfed state, as we could more accurately call it, it's a terrific app. I've used it from time to time. I don't tend to use it in an ongoing basis because I'm just sort of used to eating at a particular time of day now. But anytime I've shifted that window, for instance, a few weeks ago, I started moving that protein intake in my entire feeding window earlier in the day. And because that takes some attention on my part, because I'm not used to doing that. I've been using the Zero app and I like it quite a lot. It logs your progress and it gives you averages and you can see how many other people are fasting again, totally zero cost. I actually don't know who owns that app, but I think they've done an excellent job. The interface is really terrific, and as far as I know, it's available for Apple and Android, but it's at least available for Apple phones, which is the type of phone I happen to have. So check those out, My Circadian Clock.

#### 02:08:20 Odd (But Common) Questions

You just put that into Google, you'll find it. And the Zero app, both excellent zero cost resources. In a moment I'd like to review the parameters of a ideal feeding schedule for you and give you the variables that you can plug into your lifestyle and your preferences. There are a couple of things that I would place into the category of frequently asked somewhat odd, but still worthy of discussion. For instance, people have asked will brushing your teeth with toothpaste, break your fast? I think unless you're swallowing the toothpaste, no. Now if you really want to run out and get a continuous glucose monitor and brush your teeth, and you can evaluate that, but no people have asked will a half glass of wine after dinner a couple hours after dinner break your fast. Absolutely. It absolutely will. And it's been demonstrated to do that based on the one gram of sugar, kind of eerie or scary effect that I talked about before, scary and eerie, because it just seems like one gram of sugar. How could it do that?

## 02:09:23 Effects of Sauna & Dehydration on Blood Glucose

But these are metabolic processes and they are very sensitive, post-meal, a few months back, I did an experiment wearing a continuous glucose monitor. And I got a surprise when I discovered that going into a sauna increases my blood glucose quite a bit. It actually spikes it as high as a meal. And then it tends to drop back down to baseline or even slightly below baseline afterwards, when I talk to people about this, somebody said, oh, it's got to be that the continuous glucose monitor was getting disrupted by the heat in the sauna. That's actually not the case. Turns out that when you go in a sauna, because you dehydrate, you're losing water, I wasn't drinking water and you're dropping a lot of water. The concentration of sugar in your blood actually goes up. And I actually put these data out in a social media post on Twitter, and people were kind of shocked to see how much a sauna can spike your blood glucose, now I do practice time, restricted feeding, intermittent fasting. I'm not super strict about it. I use a kind of eight to 10 hour ish window either early in the day or late in the day. I saw this effect of the sauna, personally, the psychological and physical health effects of the sauna are valuable enough to me that I continue to use it. I'm just not concerned about this increase in blood glucose, to the extent that I'm going to eliminate sauna. I like to use the sauna three or four times a week before sleep, so I'll use it an hour or two before sleep. And yes, indeed it creates this big spike in blood glucose that then drops based on change in the concentration of blood sugar. I'm just not going to worry about it, now, if you're concerned about blood glucose spikes, then you might be worried about it, but in my case, it was one of those things where it was interesting and it was worthy of discussion. I thought because it was somewhat surprising to me, although it makes perfect sense why this would be the case,

## 02:11:12 The Ideal Fasting Protocol

but at the end of the day, literally, it just makes sense for me to get in the sauna. Okay. So now you've heard a lot of science. You've heard a lot of examples, even a few anecdotes, and let's come up with the ideal intermittent fasting, AKA time, restricted feeding schedule for you. And when I say ideal, I mean, what are the variables that are negotiable? What are the ones that are non-negotiable? What is ideal for you will

depend on the context of your life and what you are willing to do consistently. So, first of all, we established based on the discussion with Satchin, who is truly the premier world expert in this area, who knows the animal and human scientific literature better than anybody has written this incredible review. And for whom I consulted that you do not want to ingest food for at least I want to emphasize at least 60 minutes post waking up, second, you want to avoid ingesting any food of any kind, even one gram of sugar, remember, this is the ideal one gram of sugar even would be too much for the two to three hours prior to bedtime. He also mentioned, ideally, you are spending eight hours in bed. I didn't tell you that earlier. I saved that for now, but ideally you are sleeping that entire eight hours, but simply by being in bed for that eight hours and avoiding food after waking for an hour and before bed for two to three hours, you're starting to build out the duration of this fasted period. Remember that the sleep related fasting is particularly important for the health benefits of time-restricted feeding. Again, the sleep-related fasting is especially important because of all the cellular repair processes that occur in the liver and the gut in the microbiome, in the brain all over the body. And because of the way that that coordinates the expression of the clock genes that are then going to wick out and have many other positive effects on health, including weight and fat loss. But in addition to that liver health, et cetera, an eight hour feeding window as a target seems to be the best target feeding, at least by my read of the literature. And in discussing it with shuts such in shorter feeding windows of four to six hours, tend to lead to overeating and potentially increases in weight. One meal per day type eating do not seem to do that, but those are special cases in that most people can't adhere to a one meal per day type schedule, at least not on a regular basis. And it's not very compatible with most social schedules. Although some people may be able to adhere to that in a straightforward way, but there aren't any robust studies exploring the advantages of one meal per day. So if you feel there are advantages of one meal per day for you as opposed to an eight hour feeding window, well then by all means, use a one meal per day approach or use a four to six hour feeding window and just make sure you don't overeat in that window. Remember that most people tend to not adhere to the eight hour feeding window, they say eight hours, but they tend to eat outside of the eight hours a little bit on each side, so if your goal is a 10 hour feeding window, you might want to set it to nine hours or eight hours. If your goal is six hours, you might want to set it to seven or eight hours. And this is simply based by, I shouldn't say simply this is based on thousands, if not tens of thousands of human subject data points that Satchin and colleagues have collected

regular placement of the eating window or feeding window, every 24 hours is important. You don't have to be absolutely rigid and neurotic about this, but you don't want it sliding around on the weekends so that it starting two hours later and ending two hours later, a couple days a week, because then you start to offset many of the positive health effects that have been demonstrated for time restricted feeding. Remember if you eat your food within a certain feeding window, but that feeding window shifts by a couple of hours, it is effectively like jet lagging your system. It is effectively like traveling a couple times zones over eating there for a few days and coming back when in fact you're not traveling, that's because of the way that food adjusts, the circadian clock genes. Now you can offset some of that through the use of light. And I've talked extensively about how to use light in previous podcasts, but again, early morning and all day bright, light exposure as safely as you can, ideally from sunlight, not through a window, et cetera, avoiding bright light in the middle of the night, extremely important for mood offsetting, metabolic dysfunction, et cetera, not incidentally Satchin's early work was, he was one of the three co-discoverers of the cells in the eye, the so-called melanopsin cells that set the central circadian clock. So he was a pioneer in that field, which led him to be a pioneer in this field and so on. When should that eight hour window be placed within each 24 hour cycle? Well, let's talk about ideal ideal. If you really want to maximize all the health benefits of time-restricted feeding, you need to extend the fast around sleep on both sides. You would place it smack dab in the middle of the day. It would be a schedule in which you started eating for instance at 10:00 AM. And you stopped eating at 6:00 PM. An absolutely dreadful schedule for anyone that wants to have some semblance of a normal life. In my opinion, it's not really compatible with most schedules. Although some people might be able to do it, maybe you and your family or your friends, your, you know, you're eating a late breakfast or a, and then you're having a late-ish lunch around 2:00 PM. And then you have dinner at six. And then assuming that you go to bed around nine 30 or 10:00 PM, that is going to extract the maximum amount of weight related body fat related metabolic factor related aspects of time, restricted feeding. Some people tend to fall into a category where they do best placing that feeding window later in the day and provided it. Doesn't run too close to your sleep. Remember you needed a two or three hour buffer before your sleep, where you're not ingesting anything that's in order to extract the benefits of time-restricted feeding. Well then starting your feeding window at 12:00 PM and ending at 8:00 PM plus or minus half an hour or so day to day, it seems like a perfectly reasonable schedule for some people starting at 2:00 PM and ending at

10:00 PM will be that schedule. Of course, you have to take into consideration when you exercise. If you exercise. For instance, I like to exercise early in the day if I run, or if I do some moderate or light intensity exercise, regardless of what type of exercise it is, I have no trouble waiting until my feeding window kicks in around noon or even 2:00 PM. But if I do high intensity weight training, for instance, early in the day, or if I run sprints and I do that at 7:00 AM or 8:00 AM by 11:00 AM, I am very, very hungry and it's hard for me to do other things concentrate, et cetera. Now I'm not neurotic about my feeding window. As I mentioned before, I kind of let it expand and contract a bit around the eight hour mark, and feel perfectly free to do that too. We're talking here in, in ideals, not in necessarily practicals, but other people find that they're very hungry when they wake up early in the day. If you're one of these people or you're somebody who really is trying to emphasize hypertrophy or maintenance of muscle, then it does seem that ingesting protein early in the day is beneficial. That it can be more readily converted into muscle tissue. And this has been demonstrated in at least one study. There's another study underway. That's exploring this further for people that are really, really interested in hypertrophy and building muscle will then time-restricted feeding is usually not the way they go. I mean, let's be honest. There are many people out there who are eating four more meals per day, and they're doing that from 7:00 AM until 8:00 PM. I realized that not everybody is overweight. There is an obesity crisis. Indeed. You know, the percentage of obesity and non-alcoholic fatty liver disease is just cosmic through the roof, at least in this country and in other countries as well, this country meaning the US but other countries as well. But there are of course, people that are trying to gain weight through who don't want to lose weight or who are trying to maximize physical performance or hypertrophy or things of that sort. And so of course time-restricted feeding for them might be as long as I'm awake, I'm eating. And I, you know, I tip my hat to those people and just say, you know, provided you understand what you're doing and the burden that, that places on some of the other processes in your body, if that's right for you, then by all means pursue that. Another thing that we can add to this summary or key points related to time restricted feeding is the use of glucose, disposal, agents, and or behaviors. If you find that you've eaten too close to a period of time in which you would prefer to be fasting, that's when a 30 minute brisk walk or even modest walk after eating can be beneficial, ingesting some lemon juice or lime juice can help lower blood glucose somewhat. And then there are the things like Metformin and berberine there, even some supplements out there that combine things like berberine cinnamon, which

can lower blood glucose and things like chromium and things that have a mild effect on blood glucose, but berberine and Metformin are very high potency glucose disposal agents. And I mentioned earlier why you would want to approach those with the appropriate level of caution and figure out the dosages for you, and, and for some people, the dosages will be zero milligrams is going to be ideal. And then of course we discussed how making sure that you're ingesting enough fluids in particular water and salt, especially if you're using caffeine in order to increase your levels of alertness, regardless of where that caffeine source comes from coffee, tea, or otherwise, that can cause the excretion of sodium and can lead to a kind of shakiness, a lightheadedness and the feelings of hunger that may or may not be related to blood glucose. Some people genuinely need to eat. I certainly would not want to see people getting hypoglycemic to the point where it's dangerous. Certainly if you are diabetic, you, and in fact, for all people, you should consult with your physician when exploring any major changes to diet or additions or subtractions of anything, including supplementation, but for most people maintaining relatively low to modest blood glucose levels is going to be pretty healthy and will allow all the positive effects of intermittent fasting to occur. And when you find that reaching that start to the feeding window is challenging that ingesting sodium can often stabilize your system mentally and physically, and allow you to reach that window often painlessly. And then as a final point, as I mentioned earlier, provided that they are consumed in low, no or modest amounts, artificial sweeteners, or plant-based non sugar, non caloric sweeteners don't seem to really impact blood glucose to the extent that it would quote unquote, take you out of your fast, but that like fat fasting is something that's going to be highly individual, and that you're going to have to experiment with for yourself and being able to recognize when you're in a fast and when you're out of a fast, at a subjective level and not constantly having to measure your blood glucose or do things of that sort can be beneficial. And I think if you watch for the feelings associated with eating and post eating foods of different kinds in different amounts, and you watch for the feelings associated with being fasted for long periods of time or short periods of time of having gotten sufficient sunlight of having trained harder, not trained hard earlier that day, et cetera, you can do the most important thing, which is to start to learn, to evaluate your own system, to run simple, safe experiments on your system in a way that allows you to really establish the ideal nutrition schedule for you,

02:24:00 More Resources, Ways to Support Us, Supplements

whether it be time restricted, feeding, AKA intermittent fasting, or some other nutritional plan. If you're learning from and or enjoying this podcast, please subscribe to our YouTube channel that really helps us. In addition, please feel free to leave us comments about this episode or other episodes. If you want to make suggestions about future episode guests or episode topics, please do that in the comment section as well. Please also subscribe to the podcast on Apple and Spotify and on Apple, you can leave us up to a five star review. In addition, if you're not already following Huberman Lab on Instagram there, I do brief posts about science that often are not covered on the podcast. So that's Huberman Lab on Instagram. We're also on Twitter also @hubermanlab. Recently we launched a clips channel Huberman Lab Clips. Please check out our clips channel and subscribe there for brief excerpts from the various Huberman Lab podcasts. In addition, please check out our sponsors that we mentioned at the beginning of this episode, that's a terrific way to support the podcast. We also have a Patreon it's [patreon.com/andrewhuberman](https://patreon.com/andrewhuberman). And there you can support the podcast at any level that you like, during this episode. And in many other previous episodes, I discussed supplements. One issue with supplements and the supplement industry as a whole, is that the quality and amounts of supplements often varies tremendously. Therefore we've partnered with Thorne, T-H-O-R-N-E, because Thorne has the absolute highest levels of stringency with respect to the quality of ingredients and the amount of the ingredients matching what's on the label. If you want to see what I take and get 20% off any of Thorne supplements, you can go to Thorne, [thorne.com/u/huberman](https://thorne.com/u/huberman). You'll see the list of supplements that I take. You can get 20% off those. And if you enter the thorn site through that portal, you can get 20% off anything that Thorne makes. I know we covered a lot of information today. I hope you learned a lot about time, restricted feeding. I hope you learned a lot about metabolism and energy and health and how when you eat is as important as what you eat, and last, but certainly not least thank you for your interest in science. [offbeat uplifting music]