Introduction to the Ketogenic Diet

RAMON SODANO: This is Introduction to the Ketogenic Diet. I know it says 6:00 to 6:30. Even though we're starting a little bit late, I would anticipate this going a little bit longer per usual of my webinars.

My name is Ramon Sodano. I'm assuming a lot of you watched a lot of my webinars before. I guess I'm just being kind of cocky. I hope you have, I guess.

But if you have not, I work as the Coordinator of Fitness Services and Education at the Student Recreation Center at WSU. So I oversee the personal training, weight room training. This means small group training and Wellbeing Online department.

So I'm also an adjunct faculty instructor for the school. So I teach things like KINES 311, which is strength training, and KINES 305, which is essentially sports nutrition. So it's nutrition related to fitness and sport.

I've been in this field for a long time. I've given my introduction a bunch of times. And I feel a little pedantic, right. So often, I don't need to go through all my certifications and that kind of stuff.

So today we are going to be discussing the introduction to the ketogenic diet. So let's see if this will actually work. Word. OK, we're doing good. We're doing good.

My technology standards aren't the best. And we're doing better this time. We figured some things out.

So today what we'll be going through is we'll talk about the basics of macronutrients. If you just went through My Protein 101, the webinar will just be a quick review of those kinds of things. I just want you to completely understand what the macronutrients are and how it's important to understand those as the background to understand what's happening when we're going into a ketogenic state, or what's happening with ketothermogenesis in the body, and those kinds of things.

I want to talk about a little bit of the keto history. I'm sure a lot of us have an idea of where the ketogenic diet started from. But then I learned some other kind of cool things that were interesting.

And we'll do a brief history of the ketogenic diet, where it came from, basic terminology, which I understand when we get to things like gluconeogenesis and those kinds of things, it doesn't sound like basic terms. But we need to run through them to make sure that everyone understands what they are because they will come up multiple times throughout this lecture. And I'll always remind what they are, but just to kind of foreshadow on them.

Then we're going to go over the basics of bioenergetics. And do not fright at this. Bioenergetics is a deep, dark rabbit hole that is like-- it's my passion. When I get my PhD, I would like to get my PhD in bioenergetics. But we're going to talk about it hopefully on the most surface level area.

I literally spent two hours developing that section, completely pulled it all. I'm like, this is too confusing. Let's get it back to the basic level. So we will talk about it in basic terms or at least give you an understanding on the surface level of things. If any of you out there have a lot of experience in it, I apologize that we won't be breaking it down completely to every intermediate factor within the Krebs cycle or those kinds of things.

Then we'll talk about understanding ketosis. And that's essentially the bioenergetics of ketosis. We'll talk about how to get one into ketosis. So we'll do breakdowns of how much percent of carbohydrates, to fats, to protein, do we need to be able to establish a ketogenic diet? We'll talk about it in two different ways. We'll do percentages and then we'll also do grams per kilogram of body weight.

And then let's talk about how it's super interdependent. Then we'll talk about some of the benefits of the ketogenic diet, not all of them. Not all encompassing, just some cool ones that I thought about, that I think are interesting. And then we'll talk about some basic misconceptions that we see. And then we'll have questions at the end.

So with that, we'll just keep on rolling through. So first off, we're talking about macronutrients. Our macronutrients are protein, carbohydrates, and fats. They are things that we need in large amounts of. And they provide the body with calories. So macro being we need them in big amounts. And nutrients being they provide the body with something.

These macronutrients actually provide calories for the body to complete certain tasks. And typically what we see is our carbohydrates and our fats are utilized for energy production, kinds of things. And our protein is to be able to establish anabolic factors within the body, maintaining tissues, helping synthesize hormones, and these kinds of things.

Anabolic factors not really being broken down for their energy source to have us make the functions take place, while proteins, and the amino acids that they are made up of, can contribute to our energy productions. We typically don't want them to be a big energy production. That means that we're taking away from those tissues and needed systems in the body that those amino acids are needed for and maybe possibly going into a starvation state. So we would much rather focus on carbohydrates and fats to be able to do these things.

However, when we do talk about things like, yeah, the gluconeogenesis, and we talk about it in depth in our protein chapter, of how proteins can be utilized for energy. But at the most what we don't want it to be used for that, on a small amount, no matter what they are used for. Carbohydrates and fats are our dominant source of energy-- or nutrients that we utilize for energy.

And to kind of break that down a little bit more, carbohydrates, when you eat carbohydrates, they are broken down to digest in the body into a molecule called-- well, they're broken down into various saccharides, disaccharides, polysaccharides, whatever makes them up. But at the end of the day, they're going to be broken down into glucose.

And glucose is blood sugar. And this is what we're going to be able to utilize for energy within the body. It's the preferred energy source of the body. So you have free form glucose that's floating around in the blood. And then you have stored glucose, which is called glycogen. So glycogen is just the stored form glucose.

And then fats, when you eat them, they're going to be broken down into their fatty acids. And they're stored as these things called triglycerides, which is a glycerol molecule with three fatty acids. And we won't be focusing on glycerol today. But we'll be focusing a lot on fatty acids, as many of you know, that the carbohydrate-- I mean the ketogenic diet is going to be utilizing and manipulating fatty acids in a way to be able to utilize them as our dominant source of energy.

So just remember at this point that carbohydrates when eaten are broken down into-- at very end of the day, at the very, very end of the day, they're broken into glucose. And when they are stored in the body, they're stored as glycogen. Fats are broken down into their fatty acids. And they're stored as triglycerides. And that's a glycerol molecule and three fatty acids.

Also, just know, proteins, I'm sure a lot of you know-- and I would definitely recommend, go check out or go to 101-- it was probably more of a 201 kind of a webinar-- but we'll talk about what really goes on, the difference in amino acids. When we eat our proteins, they break down into their individual amino acids that are utilized for a myriad of things. Myriad, myriad, I always say that word wrong. I don't know.

So this is before-- this is just to kind of give us a foreshadow of what the ketogenic diet is. This is not where we go into the biochemistry and that kind of stuff.

Essentially, what the ketogenic diet is, is its a metabolic state in which your body uses fat and ketones rather than glucose or sugar as its main fuel source. And we're able to do this by manipulating the body in a way where we're depriving the body of carbohydrates coming in. So there is no available glucose. We only have enough glucose and glycogen stored in the body, into the liver, to be able to really start us to sustain us for a day or so.

And at that point, there are certain functions-- or operations, systems, functions, in the body that are specifically fueled by glucose. And glucose is the preferred energy system for these things. And the big one is our brain. So the brain consumes energy at 10 times the rate of the rest of the body per gram of tissue. It is a very greedy area.

And it was thought for a long time that glucose is the only thing that can actually feed the brain. It's actually the only thing that can be utilized as an energy source. However, ketones can actually be that energy source for the brain. So fatty acids themselves cannot cross the blood/brain barrier. But after they go through ketogenesis and go into the state in the liver to where they're turned into the individual ketones, those ketones actually can cross the blood/brain barrier and act as fuel for the brain.

And then essentially what we're doing is we're shifting-- the body's really at rest and at low intensity rates of exercise and those kind of things. That really is the dominant source of our energy supply. But there is a large amount coming from carbohydrate and glucose.

What we are doing in this ketogenic state and during the ketogenic diet is we are shifting the proportion of the utilization of fat even greater than it was at normal stage because we're completely depriving the body-- not completely, but almost depriving the body of exogenous forms of glucose and carbohydrates. And again, the body can generate glucose from other sources through a process of developing gluconeogenesis. We'll talk about gluconeogenesis here in a little bit. But it's not to the extent to where we support those functions as necessary.

So the body was smart. Like, we had to develop a system when we were hunter/gatherers and when we were wandering the Sahara, to be able to support our functions, especially our greedy brain, when we didn't know when the next meal was going to come. We were really a feast/famine kind of individual.

So the body was smart. And it stores fat on it. And that's why our body is still to this day is able to store fat on it because when we run out of this supply form-- or this preferred form of glucose, we can convert back to a different energy system within the body to be able to develop these ketones to sustain the functions of the brain, other functions of the body, and functions of muscle and other systems that are being utilized to create energy. Now, remember, we only have so much glucose stored-- my bad-- glycogen stored at one time to be able to build support us. So that's when we will revert back to being able to utilize those ketones as our energy system. And I thought this was easy, little kind of picture to be able to kind of understand that.

So that's just a brief understanding of what the ketogenic diet is. Essentially, it's a high fat diet, very minimal carbohydrates, if any carbohydrates, and moderate protein. And we'll talk about why it's moderate protein, why we don't go to super-high levels of protein on a ketogenic diet because it would create an insulin response and kick us out of ketosis. You need a lot of protein though.

But first, I kind of want to talk about the history of the ketogenic diet and where it came from. And I'm sure a lot of you know that the ketogenic diet was initially utilized for epilepsy or individuals were are epileptic because it actually have an antiseizing effect with it. However, before that, what happened, there was this guy named Bernard Macfadden, who you can see in this Physical Culture magazine. He changed his name to Bernarr McFadden because, according to him-- this is really a quote-- "it sounds more like a lion roar."

He was like one of the first meatheads that we really had out there. He's your typical, kind of came from nothing, to developing into something kind of story. And he essentially started the first men's health magazine. It was called Physical Culture.

And he would be an individual that would go around and very much prophesize or preach about the benefits of healthy foods, exercise, making sure to get your vegetables in, and all these kind of stuff, kind of like the very first individual for preventative health care. He was very much criticize the pharmaceutical companies and the types of medicines that were being utilized for all kinds of different ailments, diseases, and those kinds of things.

And he ended up creating this Macfadden Sanatorium or the physical culture sanitarium in Michigan. It was actually across the street from the Battle Creek Sanitarium, which is where Kellogg's cereal was developed. I read this really interesting article on this individual. We can post the article. If you're interested in the history of the ketogenic diet, it's a pretty fascinating article.

Anyways, he opened this place. And essentially it was like-- there's rings, and dumbbells, and Turkish baths, and so on. There's all kinds of stuff that you would see in essentially a rec center, right. And he would bring-- all kinds of individuals were in.

And he would actually treat them. He was considered a doctor. And he would treat them for different sicknesses. And some of the individuals that came there were epileptic individuals or individuals suffering from epilepsy.

And one thing that he definitely preached consistently was fasting, so going for long periods of time without eating food. And what he would do is he would put these epileptic patients on a fasting regimen. And what they would see is that they would have a drastic decrease in their seizures, something up to like-- it was like 80% to 85%.

And this was seen time and time again. And all these people were coming there. Of course, the typical doctors were calling him a quack, this kind of stuff. They weren't really taking his data seriously. And understand that back in the day there was two medications that were really utilized before-- before there was crazy stuff happening that is crazy. If you just think about old school medicine, of how they develop certain things. Like, it was demons in people's heads and that kind of stuff.

But when they got a little bit more around to the standpoints of pharmaceuticals, they discovered that potassium bromide and another sedative-- I think was called luminol-- were able to benefit individuals with epilepsy and be able to reduce the amount of seizures taking place. And the downfall to these medications was they were extreme sedatives. So you get the very zombie-like kind of individual, very lethargic and just not essentially what they were going for. You may reduce seizures. But you're turning someone into a very, very kind of down, out, very sedative. And they thought at the time that the sedative effects of these medications actually what was benefiting the seizures.

So what we saw was Bernard Macfadden and some other individuals at the sanitarium were being able to relieve these epileptic seizures in these individuals through fasting regimens. And he didn't realize at this point-- because understand when you're in a fasted state, you go into a ketogenic state. He did not understand that he was putting these individuals into ketosis. At the time he thought that he was depriving-- that the issue was in the intestines. And that he was depriving the body of certain toxins that were causing these seizures. That was his thought process.

So flash forward to-- I think it was like 1916, 1917, somewhere closer to the '20s, an actual doctor-- a series of doctors sent patients to this physical culture sanitarium, to where they went through Bernard Macfadden's treatment and fasting treatments. And they saw, time and time again, benefits taking place with the individuals that they sent there.

They copied the protocols and put them into play within their own medical institutions and presented that with the AMA conferences in the late 1900s-- not late 1900s, but like 1917, 1918. And it was something like out of like 60 patients, 87% were completely seizure-free. And so now you're getting this crazy kind of medicine from this crazy meathead dude, coming at an actual medical conference, and getting all these people-- like, just hit them in the face that it's working.

So then they start establishing-- but fasting protocols obviously are not sustainable. You can't fast somebody forever. And, of course, even though after the fast would end, the seizures come back, sometimes at a lower rate. But sometimes they would come back at the same rate.

So other individuals throughout the country were thinking about these ideas at the same time. There was other doctors that were looking at diabetes at the time. So how can we not have these diabetic comas take place? Understand that type 1 diabetes was the main issue at the time. Then type 2 diabetes wasn't even a huge deal.

And if you're saying with type 1 diabetes is, it is a autoimmune disease, to where the pancreas is essentially attacked and can no longer produce insulin anymore. And insulin essentially is this hormone that shuttles stuff in your body from place to place. There's a lot more with insulin than just that.

But essentially, insulin is going to be what shuttled your glucose into the target tissues, into the muscle tissues, to be utilized. So if your insulin isn't being produced, you're going to have high levels of blood glucose. And then when you have extremely high levels of blood glucose, you're in a diabetic coma and those kinds of things.

So then they came across this thing of fasting. They decided to try a high-fat diet. And so they removed carbohydrates completely from these individuals with type 1 diabetes, put them on, essentially, a ketogenic diet. That's what it was termed right. And they saw benefits for these individuals because they were no longer taking these exogenous stores of blood sugar in from carbohydrates, thus making these things take place.

There's all this communication going on before text messages too. It's crazy, right? Then they started attempting to-- because there were certain individuals that did not think it was taking place in the intestines for these epileptic patients. They thought there was some sort of metabolic thing taking place from a neurological kind of thing.

So long story kind of short, they were able to-- some doctors took this idea of the ketogenic diet, applied it to epileptic patients, and lo and behold, it seemed to work. And there was individuals out there who were really chasing the answer, why is this working?

And it's funny. They stumbled upon the reason before even realizing it was the reason and just disregarded it. So when measuring people's urine, they noticed high levels of blood ketones in the urine, but they were like, oh, this is just a metabolic byproduct of the breakdown of fatty acids. So it's not that we need to know about.

So at that point, they were still looking for the mechanism that was taking place. And granted, there's tons of mechanisms happening in the brain of why blood ketones are benefiting this. And so it became, then, the go-to treatment for an individual with epilepsy. And it was the traditional ketogenic diet, which is much different than what we utilize today for a modified ketogenic diet.

And we'll talk about the differences here a little bit, but essentially, the traditional ketogenic diet is a 90%-fat diet, which is very hard to maintain. It's doable, but it's 90% fats, essentially 6% protein, and 4% carbohydrates. So it's a [? 4, 1 to 1 ?] ratio, which is insane. And it's really limiting the protein just to make sure that you don't have any of those insulin spikes or anything like that to be able to trigger these seizures if that was the case.

So after a while, in the mid '30s-- this was going on for 10, 15 years as the main treatment for epilepsy. Then the EEG was essentially developed. And we were able to look at what was happening with these sedatives on individuals, like potassium bromide, and if it was a sedative effect in the brain that was actually influencing these seizures not to happen. And these doctors narrowed down that these sedatives-- the reason for-- they did stuff to cats. That was kind of weird honestly.

There's a lot of research out there back in the day apparently, and it's a little brutal because they're inducing seizures on these cats. But they were able to do it with these EEGs to be able to narrow down that sedative effect where the sedative constituent of these medications was not the reason that they were working on seizures. So what they did then is they went around-- or called around to a lot of different pharmaceutical companies and identified medications that were similar in a pharmacological structure that did not have a sedative effect be able to give these to epileptic patients.

And lo and behold, they found one that had no sedative effect on individuals, but completely got rid of the seizures [INAUDIBLE] 85%, 90% of individuals. At that point, taking a pill is much easier than following a 90%-fat diet. People could then live again, eat with their families and all that kind of stuff. And that became the main treatment for epilepsy and those kinds of things.

And at that point, then only a small amount of individuals were actually having to utilize the ketogenic diet for epilepsy. And it kind of lost its way in the time of things, and no one was really utilizing because they didn't understand what was really going on ketogenic diet. And it didn't really resurface again, honestly, until like the early '90s. So that is your history of genetic diet.

And I just thought it was really interesting. If anyone is interested in that article, it's a three-part thing, and we can all post it. It was pretty interesting honestly. So that's your history of the ketogenic diet working from Bernarr Macfadden, the original meat head.

OK so these are our basic terms. I didn't know how to make this slide any fun, so I just put red lines on it. I was like, there's not a lot going on here, so let's just make this a little bit happier.

So first off, we've already talking about what glucose is. So glucose, essentially, is the final result of ingesting carbohydrates. It's blood sugar. And it's what's utilized to be able to create all types of energy. And we'll talk about what ATP here is in a little bit. So we are able to utilize glucose to rephosphorylate ATP.

Glycolysis-- and we're supposed to be talking about slow glycolysis in here-- there's essentially fast and slow glycolysis. This is a system that we are going to break down or lyse glucose-- that's why it's called "gld"-- to be able to turn it into a certain molecule called "pyruvate," where it can then be able to be turned into all kinds of other things to help create ATP. So glycolysis is essentially the pathway to create energy from glucose.

Glycogenesis-- so we know that glycogen is the stored form of glucose. Glycogenesis is taking-- my bad-- yeah, it is taking your glucose and generating it into glycogen. So glycogenesis is you're generating glycogen [? into glucose, ?] and you're storing it.

Glycogenolysis is essentially when I take my stored form of glycogen, I lyse it, and I turn it back into glucose. So if I had liver glycogen stored, and I needed to send it somewhere in the blood, like the brain needed energy, I would break it back down to glucose because then it could transport in the blood. And that goes through glycogenolysis. It's now glucose again and then goes where it needs to go.

Now gluconeogenesis-- this is the one we're going to talk about a lot in this lecture, or webinar, what you will. Gluconeogenesis is the body's ability to take a non-carbohydrate source and turn it into glucose-- si "gluco" meaning "glucose," "neo" meaning "new," and "genesis" meaning "creation."

So essentially, I can take amino acids, and I can take them through the gluconeogenesis pathway and turn them into glucose. So it's being able to take a non-carbohydrate source and turn it into glucose. And very important for some of the things that we're going to talk about.

Insulin is a hormone. We kind of talked about this already. And we're just going to talk about it in the very basic terms of insulin. Insulin does a lot of things, but we're I talk about it for it's shuttling capacity.

Essentially, the main important thing for insulin in this lecture is that insulin is what shuttles glucose to the target tissues to be able to be uptaken into those tissues to be utilized for glycolysis or gluconeogenesis.

Amino acid-- talked about those-- breakdown of protein, the protein constituents that make up proteins and amino acids. Talked about triglycerides. Those are the stored forms of fatty acids and glycerol.

When we're talking about [? aerobic ?] and [? aerobic ?] respiration-- when we're talking about aerobic exercise and anaerobic exercise, "aerobic" means in the presence of oxygen. So you're working at a capacity that has a low enough intensity where oxygen could be utilized to help create energy. And anaerobic is there is no-- we're working at an intensity where oxygen is not being able to utilize.

So aerobic respiration is the creation of energy through respiration, breathing, and all these kinds of things. Or it's the buildup of ATP, or energy, through aerobic channels. So we're able to utilize oxygen in this creation of energy for the body. That is what a aerobic respiration is.

Phosphorylation-- [? phosphorylazation-- ?] it's the funnest thing to say-- this essentially, we're going to talk about ATP. ATP is our body's energy system-- or it's our body's energy molecule. It's like its currency, but it can do things.

When we use ATP to create energy, it breaks apart into ADP and a phosphate. So when we rephosphorylate something-- or phosphorylation is adding a phosphate back on to that to make ADP back into ATP. And that's essentially what's happening in these energy pathways.

We're taking now this broken-down form of ATP, which is our energy molecule that creates energy for us. After we use it, it breaks down into another molecule called "ADP," which is adenosine diphosphate from adenosine triphosphate. And then we want to add a phosphate group back onto that to make it back to ATP, and that's what phosphorylation is. And you have substrate phosphorylation, you have oxidative phosphorylation And we're going to talk about oxidative, essentially, in this lecture.

Ketogenesis is developing ketones. Genesis, again-- creating, so ketogenesis is the development and creation of ketones. Ketosis is the process that's taking place in the body. It's the state of being-- what happens through ketogenesis. Ketones are these other energy substrate that is created from ketogenesis, or the ketotic state.

And then adenosine triphosphate this one is important, so it gets its own little slide. And I kind of jumped to it earlier. So adenosine triphosphate-- and this is a great quote because we're just going to talk about it at its most basic terms-- is it's the molecule that the body's-- it's the currency for everything-- if you need to build up something, if you need to break down something, if you need to-- me talking needs ATP. Me sitting here needs ATP. Everything that we need to do within our body to be able to survive needs ATP. It's the currency that the body utilizes to create energy. When we're doing muscle actions, when lifting things up, we're utilizing ATP.

When our body is eating stuff and we're-- even when we go through and as we break down that glucose, we need we ATP to break it down. It's weird to think that in this process where we're generating ATP, we actually need ATP to go through this process. And then you develop a net ATP, essentially.

So it stands for "adenosine triphosphatee," which is an adenosine. We don't need to get into the basic chemical structure of it. And it has three phosphate groups into it. And these phosphate groups are high energy, or high-energy-yielding groups, especially the first one.

So when you break apart an ATP and you turn it into ATP, which you see on the right side, you give out energy. And then our goal is to be able to phosphorylate this ATP, turn it back from ADP into ATP so we can use it again. So your body's the ultimate recycling system.

So this is happening millions and millions of times as we speak. It's happening right now? Some people's body is more efficient with it, and somebody is less efficient with it. The thing is is your body can never complete its stores of ATP. You would die if you completely depleted them. That's why we have all these different energy systems within our body to be able to do this.

So when we have-- like we talk about the phosphagen creatine system, right? That's when we're-- we're not going to be talking about [? these ?], but that's what we're doing really, I'm 100-meter sprint, right? I'm going max velocity. I'm doing it as hard as I can. There there's a system in there to be able to rephosphorate the ATP that's being broken down, right?

So when we talk about glycolysis, when we talk about beta oxidation, when we talk about ketosis and ketogenesis, all these things are trying to do is to be able to create ATP from the broken-down forms of ATP, which is ADP, and then you can get AMP, which is adenosine monophosphate. We only have one phosphate group to it, right?

So we break it down, and we build it back up, and we're going to continue using it. We are sustainable, right? We are the ultimate recycler. So ATP, extremely important molecule within the body. And we're just going to leave it at that.

All right, now we're going to get into the weeds of things. And I purposely found the most simple picture I could find of glycolysis and beta oxidation here, because there is hundreds of things taking place within these two processes, OK? But I just want to talk about simple-- what's going on, right?

So during aerobic respiration-- so right now, we are all on aerobic respiration, right? When we're doing low grades of activity that require-- that we can allow oxygen to get into our body. We're utilizing oxygen. We're using the aerobic respiration to create ATP.

Typically, during our typical conditions-- and I say typical, which this might not even have been typical for our hunter-gatherer individuals, because they might not have had as much-- well, they definitely did not have as much source of carbohydrate as we did, right? But in typical conditions today, what we see is the dominant amount of ATP production comes from slow glycolysis and from beta oxidation. And this is when we have our typical Western diet coming in from 45-65% carbohydrates and those kinds of things, right? I'm not going to go down the rabbit hole of the difference between fast and slow glycolysis. Just understand that slow glycolysis is what we're going to-- just think about glycolysis as glycolysis.

So these two energy systems, glycolysis and beta oxidation, which glycolysis is utilizing glucose and beta oxidation is utilizing fatty acids, are our two main systems that are going to create energy, i.e. ATP, for us to be able to complete tasks whatever it is-- talking, standing, cellular turnover, cellular death, me walking to that door-- whatever it is, these things are what is providing the energy for us.

So we're going to walk through these things very basically, and we're going to explain on a very basic surface level what's happening, and we're going to talk about the reason why we have oxaloacetate up there is because it's important to ketogenesis.

So we're going to talk about these two normal energy systems first, and then how, when we deprive ourself from one of them, how ketogenesis or ketosis comes into play. OK, so can see my little thing here, or do I have to be over here?

ANDRIA DONNENWERTH: Yeah.

RAMON SODANO: They can? OK. So OK, so here we have glycolysis, OK? And this, again, is our pathway of turning glucose into energy, all right? So we have glucose here. We have glycolysis here, OK? There's tons of things going on in glycolysis.

And if you are a bioenergetic nerd out there, I understand that in glycolysis, one molecule of glucose is being lysed in half with two different, three carbon molecules. So everything's happening twice, right? We don't need to go through all that in-depth stuff, right? We just need to think about turning glucose, essentially, into ATP at the end of the day, OK?

So when we go through slow glycolysis, right, the end result of glucose is going to be pyruvate, OK? And fast glycolysis, lo and behold, is actually lactate. But we don't need to go there. So our end result is pyruvate, OK? Throughout glycolysis, we actually had a little bit of production of ATP anaerobically, which is called substrate phosphorylation. But it was only two ATP were developed right? And I make my students learn about how much ATP is developed and stuff like that for one term but we don't need to do that here, right?

So just think about it. We have glucose, it goes through glycolysis, turns into pyruvate. Pyruvate, then, is going to be turned into acetyl-CoA, OK? Acetyl-CoA then goes into this thing called the citric acid cycle, also called the Krebs cycle, also called the TCA cycle. They're all interchangeable names.

I like the citric acid cycle, because essentially, what happens is pyruvate turns in to acetyl-CoA, and then acetyl-CoA is processed by this thing called oxaloacetate which is actually, in turn, also created from pyruvate. And these two things, when processed together, turn into citric acid. And then it goes through this big turn of all kinds of different intermediates kind of reacting with it, and it develops-- well, one, it develops another two ATP, right?

But it actually develops, more importantly, all these different electron carriers which go to this place called the electron transport chain, which is where the dominant amount of ATP is developed. So as this acetyl-CoA reacts or is processed by this oxaloacetate, it has all of these different stops and along the way which, essentially, develop these things that are shifted off the citric acid cycle and sent somewhere else to be able to create ATP, OK?

So the same thing happens with our fatty acids, right? So our fatty acids are broken down through a process called glycolysis. So you have glycolysis, then you have lipolysis, right? And they're broken down into fatty acids and the glycerol. But again, we're just talking about the fatty acids. They go through this process called beta oxidation.

Beta oxidation itself actually sends off these electron carriers to be able to go to this electron transport chain to be able to produce energy. But then, they are also turned into acetyl-CoA. And then, when the acetyl-CoA goes into the citric acid cycle, again, it reacts with oxaloacetate, and it goes through this big cycle creating ATP.

So both these things are taking place when we're going through aerobic respiration, right? And we're still getting some mechanisms from our phosphagen cycle and stuff like that. But for the most part, our dominant ATP development is coming from here.

Now before we move on, I need to talk about oxaloacetate and what's happening here, because oxaloacetate is a very important molecule when it comes to ketosis or ketogenesis. So pyruvate also creates oxaloacetate, and it actually creates it through gluconeogenesis. But oxaloacetate is needed in the citric acid cycle to be able to process acetyl-CoA to be able to turn into citric acid where it's going to go through this entire process to create all this ATP.

So we have enough glucose coming in the body. We have an ample amount of pyruvate to be able to be left over for the citric acid cycle for acetyl-CoA both resulting from pyruvate from glucose and acetyl-CoA resulting from beta oxidation from lipolysis of fatty acids to be able to create this harmonious amount of all this ATP.

OK, so that's, in a nutshell, what is happening during aerobic respiration and our basic utilization of bioenergetics in the body. So now, when going to the ketogenic state-- that's right, got to go left here-- we are going to see a little bit of a difference. And I say this is-- we say this is typical conditions, right? And this is typical conditions because we are so available to have carbohydrates for us now that we're consistently being able to feed the system that's the preferred system.

It's very efficient, right? I don't know, necessarily, that our hunter-gatherers actually utilize this system and it could be considered typical for the dominant amount of our evolution, because we were typically in a fasted state looking for the next meal, right? So we're consistently breaking down our fatty acids without the presence of glucose. So who knows if this really is the typical condition for the human body.

So that brings us to this fun picture. And honestly, while this may look like a lot, trust me, when you look at all these things together, what they really look like, this is kind of nothing, OK? But there's a lot going on here.

So what I'm going to do first is I'm going to break down, essentially, what we're talking about here. So now we're talking about ketogenesis-- so the development of ketones. And this is going to happen by either being in a fasted state or by depriving the body of carbohydrates coming in. So now we're no longer have-- glycol is still happening, right? There's still a little bit. But we are greatly depriving the amount of carbohydrates coming in to be able to go through glycolysis, OK?

So we see this happen in very low carbohydrate diets-- i.e. the ketogenic diet-- or we see this during fasted states or starvation, OK? So we have a very minimal amount of glucose coming in, OK? Now, what is going to happen from this minimal amount of glucose coming in?

We remember that when we eat carbohydrates, they turn into glucose in the body. Insulin is then released, right? So the glucose in the body is a signal for the body to release insulin to take this glucose molecule where it needs to go. When we don't have glucose coming into the body, there is no insulin production in the body, right? There still is, but there's not the same amount of insulin production, right? And when there is this low amount of insulin production in the body, the body tells itself to break down triglycerides and the fatty acids at a greater standpoint than it typically would because it needs to get energy from somewhere else, and glucose is not coming in.

Additionally, and I forgot to put this on the "basic terms" section, there there's another thing in the body called glucagon. And when we don't have glucose coming in, we have elevated levels of glucagon. And that is also a signal to the body to begin breaking down more fatty acids through beta oxidation, OK?

So now we don't have the glucose coming in, so we don't have as much glycolysis taking place, which means we don't have as much pyruvate being developed. Granted, pyruvate can be developed from other sources in the body, but the dominant source is coming from glycolysis, OK? So what's happening is we're having less pyruvate being developed, and we have more acetyl-CoA actually being developed from this breakdown of fatty acids.

So what we talked about is that the body is smart, and there is systems or things in the body that require glucose no matter what, right? So while the brain can feed off ketones and it can be utilized [? predominantly ?] through ketone usage, there is a bare minimum that the brain has to get from glucose. Also, your red blood cells and your kidney needs to have a certain amount of glucose, right? It's a small amount.

So our body is smart, and it's going to go through a whole gluconeogenesis pathway to be able to develop that glucose. However, the gluconeogenesis pathway needs a little amount of pyruvate to be able to go. I believe live gluconeogenesis is an 11-enzyme sequence, right?

And going through these sequences, it needs pyruvate to be able to star in this gluconeogenic pathway. And it also needs oxaloacetate, right? Remember, we said that this is important an important molecule in this.

So oxaloacetate is needed to be able to take these non-carbohydrate sources and turn them into glucose. So now what's happening is this oxaloacetate that we have a little amount of because it is turned-- oxaloacetate is developed from pyruvate-- is being diverted from the citric acid cycle or the Krebs cycle to be able to allow glucose to be developed through gluconeogenesis.

Now, remember that we need oxaloacetate within the citric acid cycle to process acetyl-CoA. So we still have a little bit of an oxaloacetate being in the citric acid cycle to be able to process that acetyl-CoA, but by no means enough to support the max amount that's being now developed through this excess amount of beta oxidation taking place because the body, again, is signaling the body to break down more fatty acids to be able to develop and support the energy functions that are needed for the body.

So essentially, you get a backup right here-- that's why these lines are right here-- for this acetyl-CoA. However, the body has a system to be able to deal with this extra acetyl-CoA. So ketogenesis happens in the liver. So essentially, in simply thinking this acetyl-CoA is diverted to the liver, OK? Or it's already happening in the liver, OK? And this is happening in the mitochondria of the liver, OK?

So what happens is acetyl-CoA goes into the mitochondria, and it goes through a whole other bioenergetic pathway, right? It combines with another acetyl-CoA. It turns into this, and it turns that. It that goes through a bunch of other enzymes we don't need to talk about.

But the end result is it develops these ketones. And it develops acetyl acetate, beta hydroxybutyrate-- beta hydroxybutyrate, and acetone, right? We're just going to call them, ketones, OK? That's all we really need to know. Beta hydroxybutyrate really is the big one that we're looking at, right?

So the liver, then, develops these ketones from this excess amount of acetyl-CoA that is being utilized in the liver. Now, the liver doesn't actually utilize ketones as an energy source. So lo and behold, it dumps it into the blood. And now these ketones can be sent to the brain for function, can be sent to the muscles for function, can be sent to all those other areas that typically call them glucose for their function and for the development of their ATP and those kinds of things to be able to have energy production.

So at this point, beta oxidation and ketogenesis are the dominant supplier of ATP. Now, remember that the body does need a small amount of glucose to be able to maintain certain functions, and that's what we're getting from gluconeogenesis.

Additionally-- and this is what's lost on a lot of people-- is the muscles throughout the body can usually store about 350 grams of glycogen, right? And we're actually able to top off the body's stores of glycogen through gluconeogenesis of amino acids without really damaging our amino acid profile. So when it comes to our workouts and those kinds of things, our muscles are still pretty topped off to the amount of glycogen that they need that was developed through gluconeogenesis, which kind of-- that helps us with this whole myth debunk that you aren't able to function as well performance-wise when on a ketogenic diet, which we'll talk here in a little bit.

OK, so we went through a basic bioenergetics of the body and of ketogenesis, right? And I just want you to see that you understand what's going on during ketosis, right? It's important not-- my goal is always to take a complex subject and be able to make it simple, right? And I understand that maybe it's not the most simple thing, but hopefully, you have an idea of what's going on.

OK, now I want to talk about, how do you get into a ketogenic state, OK? And there's multiple ways to be able to do this, right? And we talked about the traditional ketogenic diet already. I do not recommend that. That would literally only be used for therapeutic reasons, right? Only individuals that are going through some sort of-- one, it's going to be monitored by a doctor or medical supervisor, and they're trying to treat epilepsy, or they're trying to treat some sort of neurological disease or those kinds of things. They're going to be utilizing the traditional ketogenic diet.

For most of us, we're going to utilize a modified ketogenic diet. And then I have this one over here that I call-- I call it an active ketogenic diet. And this is to where we want to make sure that we have muscle gain taking place. It's good for our athletes, and it's for those individuals who are consistently active, OK?

And understand that these percentages are all-- they could be 75% to 80%. They're all kind of interchangeable. They're all like a ratio-- not a ratio, but a range. But when we typically think about the modified ketogenic diet, we think that if we're-- so TDEE stands for your Total Daily Energy Expenditure. This is the amount of calories that your body burns each day, OK? With your basal metabolic rate, which is just all resting functions, and cellular turnover, and all that kind of stuff-- brain function and that stuff, right? And that's the dominant amount of calories that your body burns.

And then, your activity level-- me walking over here. Well, not walking, I guess. But me walking from A to B, working out, that would indicate-- that would be my activity level, and that would add on to my basal metabolic rate, creating my total daily energy expenditure.

And we have a slide in here. I'll teach you guys how to calculate that. I think, honestly, a whole other webinar would be to teach how to do these manipulations of total daily energy to identify how many calories that we need to be in a deficit to lose how much weight in x amount of time. I could have done it with this one, but you know I'm already going to go long enough, right?

All right, so when looking at the modified ketogenic diet, what we'll do is we'll quickly take our total daily energy expenditure to not gain or lose weight, and we would manipulate our percentages, right? So now, the typical American-- or the typical recommended diet is 45% to 65% percent carbohydrates. We're just going to flip that on its head, right? So we see that fats, for a ketogenic diet, is going to be 75% of your total daily intake. Protein is at around 20% of your total daily intake, and carbohydrates is about 5% of your total daily intake, OK?

Then we see, for this active one, we have a ratio of we're going to increase the protein, right-- save that muscle, right? And if you go to my protein lecture, you'll see that you actually have the ability of have a 10% to 35% coming from protein-- those kind of things. You can actually utilize those numbers in a ketogenic diet, right? And we could talk about that later if people are interested.

But at this standpoint, we're take that, you know, fats down to 65% to 70% depending on if we're doing 25% to 30%. The most important thing is to keep that carbohydrates at 5%. People will say it's most important to keep your carbohydrate level at 20 grams or less for modified ketosis to work.

OK, so these are distributions when I'm thinking about percentages, OK? Now to go through and talk about how this would work. And we're going to kind of rush through this, so if you want to go back and do this for yourself, I'll just pause this slide once you get all this stuff highlighted up.

So there are certain calculations that you can utilize to calculate your total daily energy expenditure. There's multiple out there. I'm using this one called Harris and Benedict because it does not take into consideration your body fat percentage, so anyone can do it. I would recommend get your body fat percentage taken and then utilize those calculators, or use your Apple Watch. There's a cool thing out there called a WHOOP Strap that actually calculates these things really, really well.

But what we want to do is we want to calculate our basal metabolic rate first. And again, our basal metabolic rate is our body's expenditure for all its basic daily functions, minus activity, right? And we see that the calculation for males and females are different. So our males is 66.5 plus 13.8 times by way, and it's got to be in kilograms, plus 5, times my height-- which has got to be in centimeters, minus 6.8 times my age. And that's age in what you really are. Don't try to cheat nobody, right?

And obviously, follow your PEMDAS-- Please Excuse My Dear Aunt Sally, right? Do your parentheses and all that kind of stuff first. I gave notes in here to make sure that you know this is in kilograms and the height's in centimeters.

So to figure out your weight in kilograms, remember, if you're 175 pounds, divide by 2.2. That will give you kilograms. For your height, you would figure out how many inches. So I'm 5-foot-7. So I'd go 5, times by 12, which is whatever, and then plus 7. Then I would times that number by 2.54. So there's 2.54 centimeters in every inch. So that's how you'd figure those numbers out.

Then you need to look at these activity multipliers. So to yield you your total daily energy expenditure, you need to multiply your BMR times by this activity multiplier. And this activity multiplier depends on what your current levels of activity are. You'll see there's moderate, very active, extremely active, and all this kind of stuff.

So you see "moderate" as someone who's exercising three to five times a week. So their BMR would be whatever that calories is, times by 1.55, would equal their total daily energy expenditure. And I've laid this all out here for you all so you can see them. I typically-- even though I work out quite often-- I consider myself in the moderate range.

So now I give you a little scenario, and we're doing Bill's scenario, OK? So Bill wants to get become a ketogenic-- get into a ketogenic state. So first, we see that Bill is 175 pounds, also known as 79.5 kilograms. Bill 5-foot-9, which is 175.26 centimeters, and he is 31 years old. His activity is he works out about four times per week. So this is all the information we need to know to be able to calculate his basal metabolic rate.

At this point, we plug in his basal metabolic rate, and we identify that his BMR is 1,829.82 calories. Now, to be able to figure out what his total daily energy expenditure is, we need to take that number and multiply it by the correct activity multiplier, which, if he's working out four times a week, would be around 1.55 , resulting in a total daily energy expenditure of 2,836.22 calories.

Now we need to figure out the percentages of this individual's total daily intake to be able to identify each macronutrient to create a ketogenic state. But first, we also need to understand that protein, carbohydrates, and fat have different calories per gram because these numbers are going to work into your calculations.

So understand that for protein and carbohydrates, you have 4 calories per gram, and for fat, you have 9 calories per gram. Because to be able to figure out from these percentages, from the total calories, you need to be able to divide by the calories per gram to identify how many grams you need of each macronutrient.

So we see if we want him to work at a 75 percent of the modified kind of area. We see that the total intake coming from fats will be 2,127 calories, which is around 236 grams of fat. For protein, we say he's going to be at 20%, which is about 567 calories, also known as 141.81 calories.

Remember, I'm just taking 2,127, dividing it by 9, and that's how I'm getting the grams. For protein, I'm taking 567.24, dividing by 4, and that's how I'm getting the grams, OK? And then carbohydrates, 5%. We're seeing that a total of 35.5 grams.

Now this kind of goes against that 20-gram total, right? So this would definitely put somebody into a ketogenic state, OK? It definitely would help. It is interdependent, and we'll talk about those things here in a little bit.

Now, there's also the ability to be able to do this by a body weight per kilogram of macro, right? So we already talked about that the total amount of carbohydrate-- they'll say 30 grams, but preferably 20 grams, right? And then, different institutions have different ranges for how many grams per kilogram of body weight of protein.

We go over those in depth in the Protein 101 lectures. So if you want to learn more about those, you could literally apply those ratios to this while maintaining the percentage of fat-- I mean, the amount of fat and the grams of carbohydrate.

So if you are a strength and power athlete, you could utilize the strength and power athlete ratios that we discussed in the Protein 101 lecture, keep the 30 grams or 20 grams the same, and then work out what you want for fat. So you can utilize those as well.

The one thing that drives me crazy about these ratios is they look at grams per kilogram of total body weight. I believe when you identify your protein needs, you need to base it off your lean body mass, because that is what is calling for the amount of protein needed. And we'll talk about a keto calculator that I'm going to offer you guys here in a little bit that actually provides that. And the fat, essentially, would make up the rest.

Now, what you'll see is we'll take Bill again. He's 175 pounds. That's 79.5 kilograms, right? So step one, we already got his total daily energy expenditure. We know that he's going to have

120 calories coming from 30 grams of fat, so we're going to give him the 30 grams. Then we're going to go in the mid-range, right, and we're going to identify, oh, this is about 120 grams of protein that he's going to be taking in.

So then, what we're going to do is we take 477, which is the amount of calories from the protein, and then 120 calories, which is the amount of calories from the carbohydrates, subtract it from the total daily energy expenditure to identify the calories that he needs for fat, and then divide that by 9, and that's going to be the amount of grams for fat that this individual would need.

Again, what's going to happen, especially if you're more of a lean individual, once you start using gram per kilogram or pound of lean body mass, it's nice because the protein amount is going to increase, right? But you don't want to increase your protein amount to much because it can have an insulin effect or a high-- no matter what, amino acids are going to have a small insulin effect, but usually it's, not enough to kick you out of a ketogenic state. But too much, especially at one time, could definitely have a larger effect on the insulin - [? say ?] kicking you out of ketosis.

So this is the way that you could do it, and there's multiple ways to do this, right? There's tons of information online of exactly how to do this. So I provide these resources, right? And these are different resources that you can utilize to calculate these things. If I click on one of these, will it open up on the screen?

ANDRIA DONNENWERTH: I don't know.

RAMON SODANO: We're going to try something real quick. Hopefully-- no?

ANDRIA DONNENWERTH: No, [INAUDIBLE]. It's showing this...

RAMON SODANO: Do I need to-- would that work?

ANDRIA DONNENWERTH: Probably. Yeah, there you go.

RAMON SODANO: OK. So what we see, this is, OK, how I calculate my ketogenic total. So this is an easy way just to do it on your own without having you have to do all these calculations. So let's just do me, right?

So I'm 32 years old. Well, this is a total daily energy calculator. Let's just do the keto one. This one will calculate your total daily energy expenditure. But there is ones that we have that will actually do your entire ketogenic manipulation, OK? So this is going to show what my intake needs to be for a ketogenic diet.

So I'm a male. I am 175 pounds. OK, I am short. [LAUGHS] My date of birth, let's go, where's it at? 1987, June 20. OK, you all know my-- oh, no! 1987, June 20. Right, it's in there. Cool.

So it calculates my basal metabolic rate. I'm going to go I'm moderately active. It gives me another identification of my total daily energy expenditure. This one's using a lower one, right? Very typical of them, what I was using, right? So it's giving you a different reading, OK?

Which is fine. You utilize all these to be able to identify these. Then I'm going to say I am 7% body fat, OK? And this one I like because it calculates your lean body mass, and it's going to base your protein levels off your lean body mass.

Then it talks about how much carbs can I eat? It gives you a scale of what you're going to be doing. Let's say I want to do 30 grams of carbs, because I want to enjoy a banana each day, right? How much protein should I do? OK, so a very active person, OK, choose protein, OK, 1 gram per kilogram. Let's just do that, OK?

[INAUDIBLE] protein is too low. So let's do this. So based on very active, why don't we just do-- well let's just do 168. Protein too high? Oh, that's awesome. It's too damn high. So this is asking me to do this. [INAUDIBLE]. This is weird. Is it-- I thought this would ask me to put in-- so let's just do this.

All right, we're doing 150. Grams chosen. I thought it would actually be to put in how much I want per kilogram of body weight. That's what it was asking me to do earlier, which was nice. How much fat should I eat?

OK, so I don't-- do I want to be in a deficit? So here, you can choose your caloric intake, try to moderate deficit. So eat fat like-- eat fat to your liking. You have chosen 30 grams, 150 grams of protein. This means you have already 720 calories of your daily requirement recovered, right? What's left is for you to choose how much to eat.

So I don't want to be in a deficit, so let's you say 0% deficit. So I will maintain my current body weight, OK? And then, it spits out these numbers, right? And this seems a little bit more bearable. So this one's doing a 70% intake coming from fat, and then 25% coming from protein, and 30% coming from carbohydrates.

So there's tons of ways to do this, and I just want to show you that because there are these different calculators online that will spit out this information for you. What you need to do at this point is you would need to learn how to go onto something like MyFitnessPal and be able to create your own meal plans to be able to adhere to those grand totals for your carbohydrate-- for your carbohydrates, fats, and those kinds of things, right? So you would need to go on there, and type in, I'm eating this, this, and this, and get to those proper ratios.

So this is to let you know that everybody is individual when it comes to how they handle things. I can handle carbohydrates better than Andria could. She might handle fat better than I can. So n equals 1, right? Everybody is going to respond to these protocols, these processes, different than the individual.

So women have a huge variation, honestly, and it's due to hormonal fluctuation that you all have to go through. But certain things will kick me out of keto. Certain individuals are going to be able to have a higher level of protein without kicking them out of the ketogenic state, and those kinds of things, right?

So I say, monitor yourself. And there's these things called blood ketone kits, right? This here is the Keto Mojo. This is the one that I have. It cost me $49, and I can literally measure my blood, and it measures my blood ketone levels. And then you feel like your own little doctor. It's simple, but you do have to prick yourself, and you have to have a little blood come out.

And that brings us to the point of, when we are monitoring our blood ketones, what are, essentially, the levels that we're looking at, right? So essentially, to be in nutritional ketosis, which is where I would like to be, is essentially anywhere from 0.5 to 3 millimole per liter of blood, right? I prefer myself to be anywhere from 1 to 2.

I'm not doing a ketogenic diet right now. I haven't done it for a long time. But if I was doing ketosis, I would want to maintain 1 to 2 and no more higher than 3 millimoles per liter, OK? However, even starting as low as 0.5 millimoles per liter, you're actually starting nutritional ketosis. Most people will recommend trying to stay within 1 to 2.5, all the way up to 3.

So with that, know that we call mild ketosis 0.5 to 1, moderate 1 to 1.5, and deep ketosis 1.5 to 3. So levels above 3 do not represent any further benefit, and they actually indicate that you're not utilizing your ketones at the most optimal extent. That's why they're maintaining in your blood and staying there.

So while 1.5 to 3.0 millimoles per liter is considered optimal, achieving a ketone level isn't necessary for weight loss. There's been, even, research showing that people have drastically weight loss take place at 0.5 millimoles. So when you are-- and if you ever want to use a blood ketone kit, they will give you all this information so you know how to utilize this kind of stuff. There's also, you can use urine strips and stuff like that. I think the blood ketones-- they're cheaper, right? But the blood ketone kit is much more accurate.

So here's a lot of benefits that we were talking about. We are at 7:00 PM, so I'm rushing through these sections right now. But some of the benefits that we see from ketosis is it actually acts as an appetite suppression, right? So having this fat coming in and not having to rely on carbohydrate, which has these huge blood spikes, and our body gets rid of it real fast and wants more, it actually suppresses our appetite, and actually suppresses our hunger hormone, ghrelin.

So we actually tend to eat not as much, and we actually lose weight that way. Because even though we're eating this high-fat diet, we're typically not eating as many calories as our typical total daily intake expenditure would be, so we're consistently in a deficit, which would actually aid us in losing weight. So it just suppresses our appetite.

It also is going to help him with weight loss via-- appetite suppression, and also via water loss. Understand that carbohydrates hold 3 grams per 1 gram of carbohydrates-- so 3 grams of water to 1 gram of carbohydrates. So as you rid yourself of those, water loss takes place.

So that is true-- that's why a lot of people, at the very beginning of a ketogenic diet, have a huge weight loss. So it's not always just bad. But then, you are also targeting your triglycerides and your fatty tissues to increase fat burning. So you're utilizing that at a better aspect, at a better-- yeah, aspect to be able to be utilized as energy, which helps in that weight loss.

We actually reduce blood triglycerides right-- blood fat. You would think that eating more fat in your body is going to increase your blood lipid levels, your blood triglycerides. It doesn't. We actually becoming better at metabolizing them. And when our body is actually eating carbohydrate, it concerns our fat-- i.e. stores them-- and then raises our blood lipids. So we actually see a decrease in our blood triglycerides from a ketogenic diet.

It reduces and maintains blood glucose. It actually increases capillary density in the tissues. So without increasing blood flow by increasing the density of capillaries in the tissues, that means you increase nutrient supply to those tissues without increasing blood flow.

It aids in type 2 diabetes, right? Because in type 2 diabetes, essentially, you're insulin-insensitive, but you still have insulin in the body. So by removing the carbohydrates from the body, your insulin becomes-- or, the insulin pump becomes up-regulated.

We see in the brain that we have up regulation of GLUT1, which is the glucose/ketone transporter into the brain, and we see all these other benefits, right? A really interesting one I wanted to talk about was the anticancer effects on certain types of cancer. Know that the ketogenic diet is not meant to replace typical therapy and those kinds of things, but essentially, certain cancer cells feed off of glucose because they have defective mitochondria and you cannot go through oxidative phosphorylation And due to the fact that ketones take place specifically in the mitochondria, if you're only feeding yourself ketones, those cancer cells cannot survive.

And we're seeing a lot of good research come out from that. Again, not replacing all cancer therapy, though, and only for specific cancers. This is just a nice little article I saw that demonstrated a bunch of benefits for different neurological diseases and those kinds of things that benefit from ketogenic diet. Just thought I'd throw that up there and show you that I'm not spitting stuff off the top of my head.

I actually am getting these things from published research articles-- lots of them, actually. And there's a lot of research out there if you want to look into it. I would highly recommend, if you're interested in a individual who is deep into research, his name is Don D'Agostino. His website is called Keto Nutrition, and he is a legitimate scientist that does all kinds of stuff on hyperbaric levels, and dealing with neurological issues with ketones, and those kinds of things.

So some misconceptions-- understand that ketosis is not the same as ketoacidosis, OK? So ketoacidosis typically takes place in type 1 diabetics who have runaway ketones and blood glucose levels. So if you're not taking your insulin levels-- and remember, type 1 diabetics are no longer producing insulin. Insulin is what shuttles your glucose into the target tissues that eat it.

If you have glucose rising and you're not taking your insulin, your body is not producing insulin, those blood glucose levels rise. Your insulin levels are already low. Your body tells you, oh, there's no insulin levels. Glucagon raises. We tell the body to break down a bunch of fatty acids, turn them into ketones. This turns into a vicious cycle, developing a high rate of ketones, a high rate of glucose. That puts you in a ketoacidotic state, which is literally fatal.

But ketosis and ketoacidosis are two very different things, and a typical ketogenic diet will not-- you have to be at 10 millimole per liter, right? A ketogenic diet will not put you into ketoacidosis.

Ketosis does not increase your metabolism. A lot of people are like, oh, I'm going to increase my total daily energy expenditure by going into ketosis. If you eat the same amount of calories on the ketogenic diet as you're total daily energy expenditure, you're not going to lose weight. You may burn a little bit more fat and all those kinds of things, but you're going to maintain the same. Body composition and all that stuff comes from calories in versus calories out. It's not increasing your metabolism.

Your performance doesn't typically drop off from ketosis, right? If you are keto-adapted and you're able to utilize ketones at a high capability, you've been on the diet for a long time, your body will utilize those ketones just as efficiently as they would glucose. People that have utilized research with exogeneous ketones to be able to see if they would have a performance effect gave these to athletes who were not keto-adapted and never utilized them before. So of course, you give the body something that's it's not used to, it's not going to perform at the same stage.

So it's not true that you don't have energy for intense workouts. I already talked about how you also have enough gluconeogenesis to be able to top off the muscle supply of glucose or glycogen to be able to supply for those different workouts and those kinds of things. Muscles do not deteriorate on a ketogenic diet unless you don't have enough protein coming in.

And the keto flu does not last forever. Understand, when you first get put on a ketogenic diet, when you're shifting from utilizing glucose to ketones, you're not going to feel great, right? It's going to be headaches. There's going to be some things. You don't feel super good. It's going to take a week or two to really adapt to it, right? To adjust to it. And it takes anywhere from eight months to a year to really adapt to being able to prime yourself to being able to utilize these ketones. But that keto flu will last max two to three weeks.

I'm rushing through all this right now, because we're towards time. Which then says, I want to talk about conditions that require medical supervision. Understanding if you're utilizing a ketogenic diet, you're a type 1 and type 2 diabetic, that's insulin or oral medications, make sure to do this in the presence of a doctor. If you're utilizing it for high blood pressure or on those high blood pressure medications, you have liver, heart or kidney issues, you have a history of gastric bypass, if you are pregnant, I would not recommend it.

Definitely, individuals who do not-- should avoid the ketogenic diet-- pregnancy, and individuals with rare metabolic conditions that are typically diagnosed in childhood, such as enzyme deficiencies that interfere with the body's ability to make the use of ketones, right? So remember, there's all those different enzymes that create these things that take place. So is there any questions?

ANDRIA DONNENWERTH: We did have one comment. She's not here anymore, but just she wanted to know if the female calculation was a typo? Because it's like 655.1, whereas the male said [? 66.5 ?].

RAMON SODANO: It is 655.1. That is correct.

ANDRIA DONNENWERTH: Oh, OK.

RAMON SODANO: It is 655.1, yes.

ANDRIA DONNENWERTH: And the male is still 66--

RAMON SODANO: 65.1 or 66.1.

ANDRIA DONNENWERTH: 66.5.

RAMON SODANO: Yeah, so you'll see, when you calculate that all the way out, it's correct.

ANDRIA DONNENWERTH: Oh.

RAMON SODANO: Yeah. You'll see, yeah. Because your subtraction in that, if we go-- there it is. So you will have a big-- you have less of a ratio in the height-- 1.9 times by height, right? We have 5.0, right? So all those things, it comes and works out, yeah.

I would actually recommend, if she comes and watches this again, to utilize what's called the Katch-McArdle method if you're going to calculate those kinds of things, because that's the one that takes body fat into play. And again, those calculators are all online. You could type in the Harris and Benedict method, and it'll calculate it for you. Just type in "total daily energy expenditure calculator," or utilize one of those links, and it'll take you to one of those. We good?

ANDRIA DONNENWERTH: I don't have any questions.

RAMON SODANO: All right, well, thank you all for coming. This is my last webinar of the semester, but we have Primitive Shelter Building happening.

ANDRIA DONNENWERTH: Yeah.

RAMON SODANO: And then we have the nutrition one happening.

ANDRIA DONNENWERTH: Backpacking Nutrition.

RAMON SODANO: And Backpack Nutrition.

ANDRIA DONNENWERTH: And both in November.

RAMON SODANO: And they are on the Wellbeing website, Calendar Events, or on the Global Connections calendar events. Please send us interested webinars that you want to do. I'm thinking we already had interest in the fasting one. I think I'd like to do one on how to break down your macronutients and that kind of stuff, anything that you guys are-- it doesn't have to be nutrition, right? It could be whatever you all want. Just send Andria the information, and let us know.

So thank you so much.