Lesson 13: Glucose + Ketones

Hi everyone, it's Megan Ramos. Welcome to day 13 of our fasting masterclass. In today's lesson we're going to discuss glucose and ketone levels. Let's first get started with glucose levels. Many of you who have pre-diabetes, borderline diabetes or have type two diabetes, notice that your morning blood sugar levels are the highest they are throughout the day, fasting or eating day with the exception of if you do eat carbs, sugar, starch in excess quantities.

And this elevated morning blood sugar level is very aggravating to the diabetic who is doing everything from their diet and fasting that they can think of doing. Even when people start to cut out the sugar and reduce the starch intake and start to fast consistently, they're still seeing their blood sugar levels be the highest in the morning. Whether it's day one of a fast, or whether it's day three or four of a fast, our blood sugar levels are highest in the morning.

Now, what is this all about? Well, this is actually called the dawn effect or the dawn phenomenon. And what happens is about three to four hours before we wake up, our body actually sends out hormones to actually get us up and running throughout the day. So we can think of them as waking-up hormones, and some of these hormones target the liver and cause the liver to dump out excess sugar, with the intention that we will actually burn the sugar off in the morning time.

Throughout human history, we often woke up without pantries and refrigerators full of food. So we've developed this own mechanism of fueling ourselves in the morning time, so we could get up and hunt and gather and find food for the day. Now, this actually happens to everybody, diabetic or non-diabetic. Even the most insulin-sensitive person in the entire world notices this, but we notice it on different scales.

So an insulin sensitive person might only notice their glucose levels go up a teeny bit in the morning but still well within their normal range. And it might be undetectable to the eye unless you're actually looking at trends and you can see that you're always slightly higher in the morning.

Now, insulin-sensitive individuals have a lot less sugar stored in their system compared to diabetics. Diabetics are very sweet individuals and we're fasting and working hard to reduce

that sweetness to a certain extent, at least the sweetness from the sugar inside of your body, not necessarily personality.

But because diabetics do have so much sugar, they see this larger spike in the morning times, and I just want to share with you that this is the last thing that actually gets better. We worked with over 16,000 people worldwide now, the majority of them with some degree of type two diabetes. And they can have phenomenal blood sugar levels throughout the rest of the day, great blood sugar levels after they eat, but if their morning blood sugar levels are still lingering up there it leaves them feeling uncomfortable.

Be patient everyone. It could take six months and it could even take a year to see those morning blood sugar levels come down and stay down consistently. You'll even have your ideal A1C level, in some cases, before you see that morning blood sugar level stays well within the normal range. So be patient, my friends.

Now let's talk about measuring progress. How do you know if what you're doing is actually working? Good question that I get all of the time is how can we tell? These lab tests don't necessarily tell us too much about our insulin resistance. Well, one way to check of course is to keep an eye on those morning blood sugars, but that's something you're going to have to be exceptionally patient with.

But what you can also do is take your blood glucose levels right before you eat a meal, eat your meal, and this will be a meal where you actually sit down and eat it from start to finish. When you finish your meal, turn the timer on for two hours. Then when the timer goes off at the two hour mark, you're going to check your blood sugar level again and you're going to see how close it is to your pre-meal blood sugar level.

Now, when our pre-blood sugar level and our post-meal, which we call our two hour, postprandial-blood-glucose level, when they're the same or very, very close just within a slight margin of one another, that's a great sign that we're starting to heal. What a lot of diabetics and people with insulin resistance will notice is that their blood sugar levels don't return to normal for three or four hours sometimes.

So this is a metric that we want to keep track of, how quickly are we returning back to our pre-meal, blood-sugar level? This will tell you a lot about how you're healing. And of course you do want to see your pre-meal blood sugar levels come down to the normal range and your post-meal blood sugar levels come down.

Sometimes what we'll even do is we'll have an individual fast for 12 to 14 hours and break their fast just with a sweet potato, nothing else. No fat, no vinegar, no fiber because those items are

going to affect how the starches digest it. But we'll have the sweet potato all on its own and then we'll do our blood sugar levels right before eating it, and then we'll start the timer for two hours and track afterwards.

This is semi-equivalent to oral-glucose-tolerance tests, but you're just putting plain starch uninterrupted into the body and you're checking to see what the rebound result is after eating carbohydrates. So over time you'll notice at first it might be four hours, then it might be three hours, but over time your sugars should come down to normal within two hours.

And you'll also see that your baseline, your pre-meal sugar and your two hour postprandial do start to fall within the normal range. And this is something that we often check every two to three months. It's not going to change rapidly. It's not going to change from week to week, so there's no need to do this on a regular basis, but every two to three months is a good check-in if you are concerned.

Now what a lot of people will notice too in general, is that when they do cut out the carbs and they do become pretty efficient at burning on body fat, well, their blood sugar levels don't go as high. They see their blood sugar levels fall into the low three millimole per liter range or in the low 60 and high 50 milligram per deciliter range. This is not entirely uncommon to see people who are mostly fueling on either dietary fat or body fat.

Our current reference ranges for normal blood glucose levels are designed for a population that are sugar burners, that are primarily and will only be fueling on glucose. But when we switch into fat burners either through our diet or through fasting or fueling off of body fat, well we're presenting our body with an alternative fuel source, free fatty acids and ketone bodies from our fat cells and from the fat that we ingest in our diet. So the normal reference range does not necessarily always apply to us.

Now, it's also important to remember as well, medically hypoglycemia is described as a set of symptoms, not a range of numbers. So it's always important if you're unsure for any reason and you see a low blood sugar level and you're unsure whether or not you should carry on with your fast, then you should end your fast.

Always check with your doctor, make sure everything is okay if you have any concerns. And of course, if you do not feel well at these lower blood sugar levels, please end your fast and seek medical attention. But more often than not, people feel just fine when they see these blood sugar levels. And if that is you, it's important to listen to how your body feels, but make sure you are also comfortable and talk to your doctor.

I just want you to know that this is something that we do commonly see. And at first it's not uncommon for people to not feel so great when they get these lower blood sugar levels and break their fast. And perhaps for a week or two, scale back the number of hours a day that they are fasting. But over time as the body becomes better and becomes more well-practiced at fueling off that dietary and body fat that you have, well, what happens is you actually start to feel better at those lower blood sugar levels, and start to feel normal.

So it's not uncommon to trend and see that you don't feel well at first, but over time you do feel better. Now, the reason for this again, is your body might see fat as a fuel source, but it's just unfamiliar with using it. So it doesn't use it very efficiently or effectively, but over time with consistent practice it will. And then you'll be feeling better because you'll be fueling more adequately off of that fat that you're ingesting or producing from your fat stores, and that's why you'll actually start to feel better with the lower blood sugar levels.

So just because your body is producing fat fuel or you are ingesting fat fuel, doesn't necessarily mean that your body's fueling off of it very well. When our bodies begin to fuel off of that fat that we're producing, we call that being fat adapted, meaning our body has become adapted to fueling on body fat.

Let me liken this to another example. My mother, because of her Addison's disease and her surgically removed two adrenal glands, has very low potassium levels. Now she needs to supplement with potassium but also get plenty of potassium in her diet. She eats a lot of salmon and spinach and mushrooms, which are great, but even then her potassium levels are low.

Now her daughter suggested that she eats bananas, but due to the fact that she's on steroid therapy for the rest of her life since she doesn't have adrenal glands, she has blood glucose sensitivity issues so I suggested that eats avocados. Well, I grew up more or less with them at friend's houses and then being part of a traditional diet but my mother did not.

She would purchase them for us as kids, but she didn't eat them growing up and she didn't continue to eat them into adulthood even when she bought them for us, nor does she really prepare them for us either. She knew we'd like them from our friend's homes or we would eat them anyways and she would buy them and let my brother and I figure out what it is that we want to do with them.

So I said, "Mom, you can't be eating bananas, it's going to make your blood sugar levels go through the roof." She didn't listen to me, she ate bananas in excess and while her potassium levels got better, her A1C got worse. So she became receptive and let me buy her a big bag of some organic avocados.

So we put them in her fridge and I go back to visit her two weeks later and they're still all there, the bag hasn't been opened. And while she recognizes that their food and the food a lot of people eat, they're just unfamiliar to her. So I said, "Mom, they're going to go bad. They're pretty ripe right now. You're not going to be able to eat all of these before they go bad. So let's just get started. You know, let's talk about ways to utilize them."

And now she eats avocados efficiently in her diet but it was a learning process for her. So likewise, very similar, your body's just so used to fueling off of glucose like those bananas and when you present the fat it's like presenting an avocado. You know it's a fuel source, you know it's a food, you can eat it but it's unfamiliar or it's mildly unfamiliar. You're not quite there yet with it.

So it does take time and persistence and consistency with your fasting and your lifestyle, but your body will get there. Some people become fat adapted very quickly like in a six month period, others take longer, 12, 18 or even 24 months to become fully fat adapted. But most of us actually become fat adapted over the course of two or three weeks to the point where we're feeling really good.

It might not be complete in total fat adaption, what's really, really optimal, but within two or three weeks of this lifestyle of fasting and eating very good, real whole foods and reducing our sugar intake, well, you can become fat adapted enough that you start to feel pretty good on your fasting days and your eating days. So much so that most people a month into their fasting journey say, "I actually prefer my fasting days because I feel better. And that's just a sign that you've become better at fueling on your own fat source.

Now, I just want to take a moment to talk about glucose trends as you're coming off of medications for our diabetics. As your doctor reduces your medications, you are going to see your blood glucose levels go up and this is because the medications are just a bandaid, keeping them low.

Now of course you need to be mindful of how high they go and how often you let them go that high, and it's something that you'll have to negotiate with your fellow doctor. But you keep in mind that yeah, reducing the medication that's keeping them low is going to make them go a little bit higher.

And what Dr. Fung and I often found this in our clinic because during that first three months of fasting, we were adjusting medication every week, every two weeks in a lot of our patients. As a result, their blood sugar levels would be slightly higher and this would make their hemoglobin A1C at three months slightly higher. But by four, five, six months because we were checking it

monthly, we would actually see dramatic drops after that first A1C, so just keep that trend in mind.

All right, let's talk about ketones, so we've chatted about it a few times. When we start to burn body fat or when we ingest dietary fat, there's free fatty acids, which fuel the majority of our body, but they cannot cross the blood-brain barrier. Now a fat fuel that's part of our fat stores and that's part of our food that we ingest that can be converted to something called ketone bodies.

And these ketone bodies think and feel all parts of your body, but they can also fuel your brain as well. Not all of your brain can be fueled by glucose or all of your body for that matter, but a significant portion of it can. And these ketone bodies are really the fuel that's going to be driving your brain during a fast, as well as supporting the fuel needs of your body.

Now some people really like to track their ketone levels, and there is an advantage of having a blood glucose and ketone range or ratio that is three or less than three. We call it the glucose ketone index where you take the ratio of glucose to the ratio of ketones, and you want that number to be three or less when you're getting into therapeutic ranges of ketosis.

So what does that mean? Well, a therapeutic range of ketosis means that when we have had that ratio of three or less, it is a signal that our bodies are primarily fueling on fat sources and ketone bodies, so fatty acids and ketone bodies during this time. So this is ideal for people who have neurological conditions, such as MS, Parkinson's disease, dementia, Alzheimer's and epilepsy, just to name a few and it's also advantageous for people going through different types of cancer therapies.

So there are therapeutic benefits beyond weight loss, and beyond blood sugar level improvement for these individuals to get their blood ketone index to under three. Also keep in mind too with glucose levels, that is a ratio of using millimoles per liter. So you'd have glucose millimoles per liter divided by ketone millimoles per liter.

Ketones are always measured in millimoles per liter regardless of where you are in the world, but in the United States and a few other countries, they do not measure their glucose in millimoles per liter, they actually measure in milligrams per deciliter. So if you're someone who checks your blood glucose levels in milligrams per deciliter, you'll have to divide that by 18 in order to get your glucose in millimoles per liter.

Just for the sake of an easy example, if your glucose is 180 milligrams per deciliter, if you divide that by 18 you get 10 millimoles per liter. And so that would be the conversion factor for our American friends and people in those few spots that still measure in milligrams per deciliter.

Now, if you measure in millimoles per liter, there's no need to make any conversions to calculate your glucose ketone index.

Fat loss for diabetes improvement, I don't necessarily think there is substantial benefit for someone always striving to have a low, glucose-ketone index. It is advisable. I do think that most of us would benefit from being in a state of ketosis that is that deep, to get those therapeutic benefits that the other neurological cancer patients are seeking, but it's not necessarily advantageous for us always to be in that deep state of ketosis.

We'll usually get there through fasting and when I'm working with someone or even on my own journey, I'm happy to get there while I'm fasting and experience that state of deep ketosis intermittently, but it's not necessarily needed to always be in that state. So on eating days if I want to eat Brussels sprouts, I don't shy away from eating Brussels sprouts. For example, I don't shy away from eating those carbohydrates because there are some benefits of coming out of that deeper state of ketosis.

Now let's talk about the actual ketone meanings, number meanings that give indications of how much weight you're losing and help you guide you for the therapeutic approaches. Nutritional ketosis meaning that we're starting to get in the nutritional range of ketones, is actually between 0.5 and 3 millimoles per liter. That's a really, really wide window.

Most of the data shows that if your ketones are between 0.5 and 1.5 millimoles per liter on an eating day, that your body is likely getting all of the ketones from nutrition and not from body fat. However, on a fasting day, if you see ketones between 0.5 and 1.5, you are getting ketones from your body fat because you're in a fasted state.

Now on eating days, the data shows and people have reported that when your ketones become above 1.5, between 1.5 and 3 millimoles per liter, that's when we start to see fat loss, in addition to fueling off of the dietary fat that you're consuming in your diet. And then of course on a fasting day, it's just a higher rate of fat burning.

Now sometimes people strive to get really high ketone levels, but having ketone levels of say four or five or six, do not mean that you're burning any more fat or fat at a faster rate than if your ketones are around three, so it's really not necessary to strive for these higher ketone levels. And we also need to keep in mind too, that ketones are insulinogenic, meaning that if they start to get too high, our body actually produces insulin to bring them back down, which is really counterproductive to what our goals are.

So having high ketones of say six or seven or eight millimoles per liter, they're going to cause our bodies to start secreting insulin, which we want to avoid. So again, it's not in our best benefit to

have these really high ketone levels. Traditionally we've recommended that people do stop their fast if their ketone levels hit seven and they're unable to bring them down.

You try to bring them down either through having some broth or getting some physical exercise in. In some cases during extended fasting, even someone might have a quarter of an avocado just to try to bring down their ketone bodies enough so they can carry on and complete their fasting goal and that's okay to do.

Often physical exercise will boost your glucose levels in the fasting state, which will lower your ketone levels. So for people who tend to be more insulin sensitive, well they are more likely to experience these higher ketone levels in someone with insulin resistance. So these individuals often find that physical activity is a good way to help plunk their ketone levels but seven is the usual calling-it-quits mark.

Some people who are very insulin sensitive may even experience ketones upwards of eight millimoles per liter, but eight after that is when it starts to not be very healthy for the body because these ketone bodies are very acidic. So they can make us feel not well and an acidic body is not a healthy body, and that's when our organs and all these physiological processes stop working very well. So it's important to be mindful to get moving if you feel good or to break your fast, and of course seek medical attention if you feel unwell.

Now you might've just picked up on the fact that I said, it's easier for insulin sensitive people to get into ketosis much more so than insulin resistant people. Now, to the fact that I mentioned earlier as well, that ketone bodies are insulinogenic, meaning that insulin drives ketone bodies down.

So ketogenic diet's become popular, and many people are checking their ketone levels these days, and they're so frustrated they can't get these higher numbers that they see. Some people are reporting 1.5, 2.5, 3 or 3.5 but your body is full of insulin when your insulin resistance and that insulin is going to keep your ketone levels down.

Now that doesn't mean that you're not fueling off body fat. You know you are, your waist size is changing, your pants are fitting differently. People are noticing that you're changing. So it doesn't mean that you're not burning body fat and that you're not fueling off those free fatty acids, and that you're not in the state of ketosis. So you always cannot rely on a meter to tell you whether or not you're in ketosis, not until you become much more insulin sensitive and that's what people notice.

At the start they can't tell, it's not there. They get so angry at their meters, their math but they're full of insulin at that time. And what happens over time, you continue to fast, you

continue to eat while your insulin levels start to come down and your ketone levels start to go up. Well, how about that trend? If the insulin that suppresses the ketones goes down, you're going to see the ketone levels go up. So if you are someone who's measuring, you need to be patient.

And also I must mention that it can be very difficult and inaccurate to measure ketone bodies when you have hypothyroidism and your hypothyroidism or Hashimoto's Thyroiditis is not optimized on thyroid supplementation, and even then some thyroid supplementation may interfere with your ketone readings.

So again, notice I'm saying interfere with your readings, not interfering with your ability to burn body fat. So just because you're not getting these higher readings because of your thyroid symptoms, does not mean that you're not fueling body fat and that you're getting deep therapeutic benefits of fasting.

All right, let's talk briefly about how you can measure your ketone levels. There are three ways through the urine, through your breath and through your blood. Now through the urine you go buy these cheap ketose sticks at the pharmacy. Pretty much every pharmacy has them because there's something commonly used by type one diabetics, especially as children, just to make sure that they're keeping their blood sugar and ketone levels in a good balance.

So they don't develop an unwanted condition called diabetic ketoacidosis, which means the body has become way too acidic from the combination of high glucose and high ketones and it's a life-threatening condition. It primarily occurs in type one diabetics.

It rarely occurs in type two diabetics and is much more prone to occur in type two diabetics if they're insulin dependent, type two diabetics, or if they're taking SGLT2 inhibitor medications, they are at a greater risk for this condition as well. So it's important to talk to your doctor about this and your medications and fasting before you get started. That's why it's so important to have a doctor on your side. All right, that's in the urine.

Now what happens is you would just stick the strip in your urine midstream, and there's a color rating from white to dark purple, and the darker the purple it is the more ketones you're producing in your urine. Now let's talk about this for a second because these are not accurate tests at all. If you wake up in the morning your body's slightly dehydrated, your urine is very concentrated as a result. So it's going to make you look like you have these really high ketone bodies but your urine is just dehydrated.

And if you go to check later on in the day, it's going to look like your ketones are a lot less, why? Because you've hydrated throughout the day, therefore diluting your urine. So hydration plays a

big role and you can drastically change these numbers from the time you wake up just by having water throughout the day. And having water isn't slowing down your fat, it's just not the best quality test.

And also what happens is when we're not fat adapted, we urinate out a lot of those ketones because our body doesn't know what to do with them so it urinates them out. But when we are actually becoming fat adapted, our body will start to use the ketones, so we won't have as much to lose her urine.

So sometimes people get so mad because they say, "We're doing everything right with fasting and diet, and we're still losing fat, but why aren't we producing ketones?" Well your body is using them and that's a great thing. That's why you're feeling good. That's why you're losing fat. But you're not going to see them in your urine at that point or not in large quantities.

So I think the ketosis urine sticks are good if you have a lot of insulin resistance, and you're just getting started. As long as you understand that they are not the be-all and end-all and they're not very accurate in general, but you can use them as a loose guide that you don't get too emotionally attached to.

Now, you can also check your ketones through your breath. There are breathalyzers out there, but I'll tell you that a lot of them just aren't accurate, especially the more inexpensive ones on Amazon. The two that have the longest standing longevity amongst individual users are the Ketonix and the Biosense and then there's a clinical one called LEVL.

Now these three meters are all good and well. The Ketonix is a little bit finicky to use for some members. The Biosense is actually quite easy to use and actually is backed by clinical trials for its accuracy and it is pricey. And then the LEVL is something that's more geared towards clinician offices, so it's not necessarily a system that you'd purchase at home.

And what these breath meters check is will they measure a ketone body called acetone. So if you remember back to our fasting side-effects video, we talked about that metallic taste and that white film on the tongue being acetone and it being a ketone body and that is what these breath meters measure. So they are a good alternative to urine. They're much more accurate and they're going to be much more consistent in their accuracy throughout the day, regardless of your hydration or any other factors, even your degree of fat adaptation and they're not invasive.

So we're going to talk about blood ketones yet, so they're not invasive. You don't have to prick your finger to liberate some blood to measure your levels. So a lot of people will prefer to check their breath ketone levels, and that works for me. It's a really great way to measure your

ketones without having to prick your finger, but still get a fairly accurate result. Now they do cost a lot up front. I believe the Ketonix or the Biosense ranges somewhere around $250 per unit. But keep in mind that that upfront cost will save you on test strips in the long term, so it's an upfront investment for long-term savings.

All right, let's jump into blood ketone levels. Blood ketone levels are by far the gold standard. They're going to be the most accurate and they're just a little bit more invasive and more expensive than the breath ketones, because you do have to prick your finger in order to measure your ketones via blood.

So blood ketones actually measure a ketone body called beta-hydroxybutyrate and this is the ketone body that reduces inflammation that crosses the blood brain barrier for fuel. It is the gold ketone body and that's what the ketone blood meters check. Now, there is no independent, solo, keto blood meter. They usually come in combination with a glucose meter, so they look and function just as a glucose meter.

Here are a few. Abbott freestyle has various models in Canada, the United States, UK, Australia, New Zealand. Their models specifically change by country. In the United States is the Precision Xtra or in Canada it's the FreeStyle Precision Neo and they are very accurate. I used the FreeStyle Precision Neo for many years myself back in Toronto, but the test strips are pricey for these devices. In Toronto I spent $2.75 cents per test strip.

Now when you use these meters, you can't use your glucose test strip to also measure your ketone levels. So you require one set of test strips for your glucose levels and then another set for your ketone levels. And these typically range from $2.00 To $3.00 US depending on where you are in the world and that can quickly add up.

Now, I think you can see why many people will elect to spend the upfront costs to get a nearly as accurate breath meter like a Biosense. But what has been really cool is if you wanted to check your blood there is a device called the Keto-Mojo. Now Keto-Mojo is based in the United States, but they sell to Canada and Europe and all across the world and their keto blood ships are around $1.00 US per strip and they're just as good quality. So they've actually been able to reduce the cost by 50% or more depending on your geographic location, which makes checking ketones much more accurate for those who want to do so.

It's a great device. I've had the pleasure of getting to know the owners of the company. I have no financial relationship with them, but it's a device that they're constantly evolving and working to make even more accurate. Recently they released their newest model, the plus. And this has left some people feeling a little frustrated because they're seeing higher glucose levels and lower ketone levels, but their plus is actually a lot more accurate when compared to blood test results.

Now all glucose and ketone meters, in order for them to be approved by Health Canada or the USFDA, for example, they only need to be plus or minus 10% accuracy, so this means plus or minus 20% accuracy. So this means if there's a 20% off range from your blood tests, that's huge, right? That's a huge range, but that's an industry standard.

While the Keto-Mojo has narrowed that industry standard in trying to give you the best at-home readings. So while frustrating, it is a more realistic expectation of what your blood test results are going to be. Now with that being said, there are flaws in devices and there are flaws in test strips. So if you have any concerns and you're using the device, always contact their customer support and they will send you a new device and new test strips if everyone suspects that something definitely isn't right with the device, but that's the most economical way to get gold standard testing, at least in today's market.