Dr. Jacob Wilson - Presentation (SD 2016)

Hello, everyone, it's great to see you.

Super excited to be here today in San Diego.

I'm actually originally from California, Northern California,

so I'm always excited to come up here on a really, really important topic.

And that topic is today the role of ketogenic dieting in resistance training

and particularly body composition.

And I think this is very important because we think about resistance training,

a lot of times we think about bodybuilders and about power lifters.

But in reality if you look at muscle tissue,

you know issues with muscle tissue across lifespan is absolutely essential.

I mean after the age of 50 people on average loose 1% of their muscle mass per year.

And it is called sarcopenia.

And in fact we have sarcopenic obesity,

where people are losing muscle and gaining fat at the same time.

When you have a disease like cancer, you have cachexia

and people are wasting muscle at a very high rate.

And so protecting skeletal muscle at all cost is very important.

So that's what...

That's the talk and myself and also Ryan Lowery...

in this presentation we do everything together.

So one of the things about me - my dad always taught me...

You know, I've been into science as little kid

and my dad got me my first Labco chemistry set when I was like five.

But he always taught me to see the world not as it is, but what?

As it could be.

Not to see the world as it is but as it could be.

And I think that everyone in this room is doing that.

A lot versus the minority here...

And we're talking about this low carbohydrate lifestyle.

So we're trying to envision how the world could be.

So how do I envision the world?

If you guys kind of follow some of the work that I do, you know I like food a lot.

And I do eat ketogenic, so this is kind of a, "What's my perfect world?"

Well, it kind of looks like this.

So I like to cook a lot.

If you look on my social media and stuff, I put recipes the whole time.

So here's a double cheeseburger, totally keto.

And this is pizza, this is cauliflower pizza.

Who said had that before?

Unreal, right?

So I had this idea, "What if you combine the two?"

So, here you go!

This is like unreal, literally one of the greatest things I've ever had...

In my life.

Here's some other keto recipes I made.

That's kind of cheesecake with some whip cream in it.

These are sugar cookies and that's actually MCT powder that's kind of the base.

That's cream cheese with a little bit of strawberry.

Giant cookie with heavy cream and those were keto Oreos.

But this is the keto lifestyle, this is the low-carb lifestyle.

People talk about like, "Oh, my God, I can't follow that."

I mean this is not hard to follow.

And we know that in this room.

But what is the world as it is?

Let's go back... this is great, we all know this.

But how is the world really?

This is kind of how the world really is.

Unfortunately this is obesity rate and we look here at what happened in the 80s.

What recommendations?

Low-fat recommendations and what happened?

Obesity sky-rocketed, right?

So what we want to know is, "What could the world be?"

The recommendations that you guys are making today

got instituted as a national recommendation.

Maybe this is what would happen.

If we take into count all this stuff together.

So that's what we want.

So there's a lot of science that you guys have presented,

a lot of researchers here presented today... that is phenomenal.

You guys have seen results in your own lives, your own families' lives.

That's absolutely phenomenal!

So how do we get this information out there?

How do we get this science out there?

So what is our why?

I think it's very important always to know what's your why.

You have to ask yourself that... "What's my why?"

Not just what I do, what's my why.

So for us our institute is Applied Science And Performance Institute.

That's a 21000 square foot facility with a laboratory...

We'll talk about that, I'll take you through what we do.

But our why is to change the course of science.

In our field we would say nutrition science,

sport science, we look at both of those.

But in general, change the course of science in general.

Because we think of science and we think about ketosis...

This is what happens.

You have this guy talking to PhD's and MD_ s.

The only people that can understand them are these guys.

And that's a problem.

Because if that's the case, if this is traditional science

and the only people that can understand the code are other scientists,

the other people are MD_ s and PhD's,

it's not getting out to general society.

So we can't change the standard.

So what I mean is that there is currently a disconnect.

I am a scientist, I grew up doing research,

I've done a lot of research for a lot of years as a lot of scientists in this room...

This is what I grew up with and here is the thing...

Every time I said something that was normal language,

I got corrected and got the word changed.

Not front, like interior, right?

Not back, posterior.

And then as I moved through by the time I was like,

"Man, no one can even understand what I'm saying!"

So there's a disconnect here.

And this is by the way...

"Right now, some guy on Twitter just said you are wrong!"

And I know Dom gets that, I' sure Dom gets that

I' sure he gets that and I can tell you right now I get that.

And there is a really critical scientist in our field on a tweet...

He's been like in a lawsuit for the last two years and he can't be here because of that.

I mean this is the disconnect that we have and we got to bridge this.

We got to make some sort of bridge between science,

the low-carb lifestyle and understanding.

So this is what we're trying to do in our institute.

So again we are in Tampa Florida.

I grew up in this Bay area, but I am in Florida Bay area now.

And we have all sorts of cool stuff.

So this is for example we try to stimulate sport.

I love sports - so this simulated baseball...

So if we do research, we can actually mimic as close as possible

what's going on, what's actually going on.

Why is it important to work with athletes in sport?

I just had lunch with my colleague Jordan Joy, I'll talk about him a little bit later.

But he made a really good point.

Think about it, everyone looks at the athletes...

If the athletes are doing it, everyone else does it.

If we can change what's going on in athletics

and show how low carbohydrate diets can impact athletics,

people will start to look even more

and I think Jordan Joy made a really good point with that.

So here we stimulated baseball, this is a simulated major-league pitcher here.

You can see...

And he's pitching it...

Sorry, he's pitching it so...

you can kind of see that right there...

Up close... he is swinging...

That was simulated golf back there as well.

Here's another example - this is a dual force player.

So say this guy is doing squats on the force play.

We could look at asymmetry in his legs...

So he's squatting.

"Look at the symmetry between his legs on the squat."

So you can look at the symmetry between his legs while he's squatting.

It's very important because that's a motor component.

You can look at balance as well.

And if someone is off-balance, how can ketones affect that?

How those ketogenic dieting affect those asymmetries?

Because with age you see that as well.

Now here is a particular athlete - there's a vertical jump curve.

You look at the vertical jump curve

and that's his left leg down there and his right leg up there.

You notice there's asymmetry between the left and the right leg.

Can you guys see that?

So we might do an intervention.

Here is an intervention.

You can see where we are instituting a reflex in his muscles.

Like when you do when your doctors test your reflexes and your knee kicks.

We are instituting like very small, rapid reflexes that activate the muscles

that he might not be able to activate as well.

So you're going to see here...

He's doing a squat here.

That's muscle activation, we have sensors on his legs.

"...which is on the upper panel, and his rectus femoris on the lower panel.

He's going to start squatting right now.

"You can see activation in the upper panel, very low activation in the lower panel.

"But we're going to use the Galileo to activate the tonic reflex,

"which will activate the rectus femoris.

"You will see it here.

"Immediate activation there and a more activation in his other leg.

"So what we're doing here basically

is using better science that engineer elite athletes at ASPI."

So we can look at cognitive functions, so again you look at the ketogenic diets...

You might look at various reaction times,

how your performance is in different quadrants on this machine here.

This is called a synaptic device.

But it is measuring again his reaction time in different quadrants.

And I think that's very important for testing

the cognitive effects of ketogenic dieting.

That's sort of the floor where we do resistance training

and performance testing and speed testing with individuals.

That's Ryan Lowery here who I said helped making this presentation with me.

This is our food science lab.

So we actually will look at different ketones, different fats

and their impact on body composition...

Different fiber sources and their impact on ketosis.

So a lot of that stuff is prepared in our food science lab.

So what we want to do, our plan is

to be able to show you guys what's happening in life.

To make science less intimidating.

That's kind of what our "why" is.

So you have the background of that.

What sparked our interest in ketogenic dieting?

I think in 2008 or 2009 I went to an experimental biology conference

and I met Dr. Dominic D'Agostino.

I like lifting weights and stuff like that

and when I met Dom... you know, he's a big guy...

And he was eating sardines all day.

And I was like, "Why are you eating sardines all day? I don't understand."

And he explained, "I am studying the ketogenic diet and things of that nature."

And I noticed he only ate once a day and he was three times as big as what I was.

So I was, "Okay, so maybe I should start eating sardines too."

But anyway, that was one of the things that sparked my interest.

Jordan Joy I told you about, he sparked my interest...

He's doing research on how many carbs an athlete can have and still stay in ketosis.

But he really sparked my interest a lot in the resistance training room.

And of course Jeff Volek.

Ryan Lowery and I, Jordan Joy,

we are at the National Strength And Conditioning Conference several years ago...

Must've been 2010 or 2011...

And Volek presented on performance in ketogenic dieting...

So I came up to the microphone at the end and said,

"Dr. Volek, what data do we have, what research do we have

in resistance training athletes?"

He said," I'll be honest with you, we don't have any."

And we looked at each other, like Ryan, Jordan and I looked at each other

and said, "It looks like we got a lot of work to do."

And what I'm going to present to you today is a lot of that work.

What else sparked our interest is...

I mean ketogenic dieting is interesting, right?

Isn't it interesting what's going on?

This is some research which is published in Journal of Applied Physiology

with Dr. Roberts.

And this is a rodent study that we did.

And what's really interesting, we keep talking about this calorie hypothesis.

Calories in versus calories out.

This study here seems to be the exact opposite of that.

So we had three conditions...

We had a traditional Western diet and that's how typical Americans eat.

We had a ketogenic diet,

we had a standard diet what's more like a low-fat moderate protein diet.

So standard diet, low-fat moderate protein ketogenic diet

and then a Western diet which is how most people eat.

The rats could eat whatever they wanted.

It turns out that the low-fat diet...

actually ate the least here, they ate the least amount.

Both the Western diet and the ketogenic diet, actually ate the same amount of calories.

Now here is the interesting part.

So this is the Western diet - their fat mass.

That's the keto diet, and that's the low-fat diet.

Now they ate the least amount of calories,

they ate the same amount of calories as the Western diet.

Now I'm going to show you a picture that changed my life.

And literally got me this fascinating...

This is the rat... If you don't like graphic, you don't want to look...

But this is basically.... we'll just look at their anatomy...

And I want you to look at their organs.

This is the Western diet with fat covering all their organs.

That's the keto diet, same amount of calories.

It looks like an anatomy chart.

That picture stuck with my mind ever since

and you just think about what's going on with our society.

It's not just a matter of calories...

There is something special going on here.

Okay so here is something that we looked at...

Ketogenic dieting and exogenous ketones.

Rats can be cute.

So here basically, what we are looking at again,

you are looking at a high carb diet...

This feed efficiency, so feed efficiency is this...

For every calorie you take in how many of the calories you get stored?

Does that make sense?

So sometimes you thought, "Man, if I look at food, I'm gaining weight."

That's feed efficiency.

So what you're looking at here is... We found this is the high carb diet.

This is the high carb diet plus exogenous ketones.

That's ketogenic dieting, that's ketogenic diet plus exogenous ketones.

Feed efficiency goes down as ketones get elevated.

So it's not just the absence of carbohydrates.

There's something going on with ketones themselves.

We actually found that thermically active tissue,

tissue that's more metabolically active, which is called brown fat tissue

was elevated in order, so it's the highest in this group.

So the thermically active tissue was higher.

So very interesting what's going on here.

So here is an outline - let's get to resistance training.

Here is the big question - "Can you gain muscle on a ketogenic diet?"

And again I think this is important because we know all the therapeutic effects.

But if you want to prevent anti-aging

and you want them to still be able to gain muscle,

that's important for function.

What about cyclical ketogenic dieting?

Can you go off keto a couple of days a week and then go back on?

What about exogenous ketones...

And wasn't that carbs?

So what do we think? Isn't that a big question?

These are just some of the things we'll address and there's so much more we can address.

That's what we're going to talk about.

So here is the first study and we actually just got...

This just got accepted for publication in the last month

in Journal of Strength and Conditioning Research.

It takes a long time, by the way, to publish a paper.

I think we started this in 2012 or something like that.

That talking about bridging the gap... takes forever to get stuff out to you guys.

So first thing we did, we took highly resistance training people, 15 keto, 15 carb.

Before we trained them, we adapted them for two weeks.

So before they started training,

their blood ketone levels were in average above 0.5 mM.

They were on a diet that was more like 70%, 75% fat,

20%, 25% protein.

So a little bit higher protein, but still 70%, 75% fat.

So we got their ketone levels up.

Did they gain as much muscle?

I hypothesize I wasn't so sure that they would.

So they started training there... Watch this.

First off, everyone says, "Oh, my training volume is going to go down.

I'm not going to be able to lift as much weight in the weight room."

So let's say you are doing the three sets of 10 on bench press.

Three sets of 10 on squats.

We add all the weight up and we get your training volume.

The keto diet and the high carb diet - same training volume, no difference.

And think about it, they were on carbs their whole life.

They twitched over for two weeks and their training volume wasn't messed up.

What happens when you are on it for one year, two years, three years.

So that's to us is phenomenal.

So that's not true - you can maintain your training volume.

And this is looking at lean mass scheme.

This is before both groups and this is after.

Both gained the same amount of lean mass.

The point is you are able to gain just as much muscle mass

devoid of carbohydrate as when you are on carbohydrate.

So you can be on this diet, you have the therapeutic effects

and you can still gain as much muscle on a ketogenic diet.

On top of that they gained the same amount of strength.

They gain the same amount of upper body strength,

the same amount of lower body strength.

Cool, right?

Oh, okay.

But, wait a second.

I mean we've been at conferences and people have come up to the microphones.

We love you guys, we are on the same page.

When we go to conferences,

I can expect there to be like 20 people online really pissed off.

"Wait a second, wait a second!

There's no way you can gain that muscle without glycogen."

Glycogen is our stored form of carbohydrate, right?

"There's no way can gain that much muscle without carbohydrates."

Well, we did.

"But there's no way that can happen.

There's no way you can stimulate protein synthesis."

Protein synthesis - you take amino acids, you put them into muscle.

That's the molecular thing that's making you grow.

"There's no way that can happen!"

So we did an animal model... The first one is a human model.

And that is a clever little tool.

So here you basically have an animal in this running wheel.

But the running wheel has resistance and, you know, they like to exercise.

There are some mice and rats that don't,

but, it's like humans.

But we got ones that like to exercise.

So they go in here and they start training kind of.

They're running around their wheel

and then all of a sudden we bump up the resistance on the wheel.

Just ever so slightly.

But they keep going.

And then we up the resistance again and again.

So they're getting progressive resistance.

Pretty cool, right?

I've done a lot of resistance training models of rats.

On climbing ladders and a bunch of stuff like that...

But anyway, this is the best one I've seen.

Now protein synthesis...

Again you take the protein through dieting and you incorporate it in the muscle.

This is at molecular level, so we're looking at the molecular level here.

No difference.

At molecular level you seem to ingest

just as much protein synthesis on carbs or not on carbs.

Fascinating!

Now this is kind of what blew our mind.

We looked at glycogen levels

and there was no statistical difference in the muscle in glycogen.

After six weeks of being on ketogenic diet, no statistical difference in glycogen...

It means that carbs that were in their muscle, there was no difference.

So they were like on a 5% carbohydrate diet.

Near the same amount of glycogen in their muscle.

And Volek's find, they're replenishing carb source in their muscle just as fast.

And that's mind blowing, isn't it?

But you can make carbohydrate that you need

without actually taking in exogenous carbohydrate.

Why is that the case?

It's something called gluconeogenesis.

You make glucose from things that aren't glucose.

Gluconeogenesis - you make glucose from things that aren't glucose.

Does it make sense?

So here's the thing.

In our muscles who has heard of branched-chain amino acids?

All right, cool, you guys are awesome.

Branched-chain amino acids are those amino acids

that are the most important for building muscle.

So you don't want to break that down.

There's another amino acid that gets converted to glucose very rapidly.

And that's called alanine.

So alanine goes down when you are on a ketogenic diet,

because it's getting used at a higher rate to produce glucose.

But the ones that are really important for building muscle, don't.

So your body's sparing muscle tissue,

but the amino acids that are most important for converting over to glucose

are being used at a higher rate.

And then I think we also think things like glycerol on fat

being converted over lactate a lot of other things.

What about CrossFit?

You know what happens in CrossFit?

This is a study from James Madison University.

Not our lab, from James Madison and they took 31 CrossFit athletes.

They put them on a low-carb ketogenic diet

and they monitored if they actually were on ketosis.

So they were training four days a week CrossFit,

they confirmed they were in ketosis... And what happened?

This is a real cool thing, look at this.

The red is the control, meaning they are eating normal carbs.

The blue is the keto diet.

Their weight went down, their BMI went down,

their body fat went down, their fat mass went down.

No change in muscle, they didn't lose any muscle.

So they became--

Think about sports all about what your body can do relative to your size.

So this is very cool stuff.

Most importantly both groups improved performance the same.

So we want time to go down unlike the squat, the sit-up, the push-up, the pull-up.

Both groups went down the same.

So their body composition drastically improved.

And their performance was able to improve at the same time.

So this is a really, really cool stuff to us.

So we found it in resistance training, we found it in a CrossFit model as well.

And here's the thing, who is here a cyclic ketogenic dieting?

So the diet that we did in our lab was more of a maintenance calorie diet.

This is a calorie deficit, we purposely put these people on a calorie deficit.

So we had them do an interval training, we had them do a resistance training.

And seven days a week they were on keto.

The cyclic group Monday through Friday they went keto

and on the weekends they were able to eat carbs.

Makes sense?

So the question is, "Do ketones play a role on sparing lean mass?"

And I think this model kind of indicates their importance.

So we had the cyclic group eat carbs in the weekends

and the normal keto group ate keto the whole time.

And there's a point that, "Oh, if I can have carbs in the weekend,

I can carb up, have full glycogen stores, etc. etc."

Now here's a interesting thing - look at the blood ketone levels.

This is the normal group.

The keto group, seven days a week,

their ketone levels from Monday through Friday were always elevated.

Make sense?

This is the cyclic group.

When did they get into ketosis?

Yeah, not until late.

They were on Thursday like, "Oh, my God, I can wait until my carbs in the weekend."

Well, yeah, because their ketones were elevated like the whole week.

You're suffering, by the time you get to that point your glycogen is depleted.

And a lot of time you hear cyclic people like,

"Oh, my God, I just feel horrible. I need carbs in the weekend."

Well this is probably the mechanism why.

But they both lost the same amount of mass.

It's weight loss there, both lost the same amount of mass.

So if you want to lose weight, maybe that's cool.

But it's weight what matters.

We got to look under the hood, right?

What's the composition?

So, look at this.

The keto-group lost basically of that mass, all fat,

the cyclic group only lost a little bit of fat.

So, what do you think they were losing? Lean mass.

Remember what I said, I think we think that ketones are sparing muscle,

that's why you can go through it fast and spare muscle mass,

because ketones are elevated.

But if you stop that mechanism from happening,

by inhibiting adaptation, you lose lean mass.

Real cool data that we actually recently got supporting this hypothesis.

This is a carbohydrate diet.

Remember the BCAA's that we talked about earlier?

So, we get BCAA's and this is when you're on a carb diet,

this how much they go up in the blood.

When you're on a keto diet they go up more,

which could suggest you are ready to look further into this,

but it could suggested that ketones are sparing the BCAA's

from being actually burned.

So, I think that's really cool to us, it's very important,

because is not just for resistance training,

but for other models that could be models of cachexia and muscle wasting.

What happens when you administer exogenous ketones on performance?

This study just came out from Beaches Lab.

And basically, so, they have a ketone drink competitive cyclists

and so, what you look at here, they took ketones,

ketones were fat or carbohydrates.

So, what you're looking at here is plasma glucose,

notice that when you took ketones, plasma glucose levels were lower

and Dom kind of talked about that when he talked about that metabolic zone,

that you can possibly administer a formula

like you can get blood glucose to lower and ketones to raise at the same time.

Ketones powerfully lower blood glucose, so blood glucose is lower.

And lactates are also lower - isn't that interesting?

Like, lactates also lower.

And at any giving intensity we lactate threshold,

like, how much you can sort of blunt that lactate response,

is very predictive of performance.

Right? So, that's lower.

But, what about performance?

They actually went 411 m further

when they took the ketones plus carbs relative to carbs alone.

So, this is very, very interesting and these are highly trained endurance athletes

and basically this is a very interesting quote.

"We have demonstrated the metabolic effects of elevated circulating ketone bodies

"as a fuel and biological signal to create a unique physiological condition.

"Ketosis may alter substrate competition for respiration,

"while improving oxidative energy transduction under certain conditions,

"such as endurance exercise.

"Consequently, nutritional ketosis may help

to unlock greater human metabolic potential."

It's a very cool stuff and very powerful statement to be made by these scientists.

Alright, so last question of the day.

This is Net Carbs or Total carbs?

I'm not telling you I can answer this question definitively

but I'm just going to show you a cool say that we actually just recently did.

First of all we think about what's in that carbs?

Often times we are thinking about fiber. Like you subtract out the fiber, right?

So, basically we think about dietary fibers non-digestible carbohydrates,

that's not digested in the small intestine and makes it to the large intestine. Right?

So they're not digested in the small intestine, so they're not absorbed.

Because for example if I eat a piece of bread, that will be digested in the small intestine

and glucose is going to rise, right?

And as glucose rises, what else is going to rise?

Insulin is going to rise, so we are going, "Oh, my God, you know,

I got to keep my carbs under 30 g. Is it net or total?"

You're really thinking about carbs that impact glucose

and carbs that impact insulin.

And once they make it to the large intestine, who deals with that?

The gut bacteria.

So, what means is when they get there,

the bacteria utilize them, consume them for energy,

by the process known as fermentation.

And that can have very beneficial effects on improving good bacteria.

And actually, when fiber gets to the large intestine and it's fermented,

it produces short chain fatty acids that have a huge health benefits

for gut health, it produces butyrate

and butyrate it's actually very ketogenic,

very ketogenic, we've tested it over and over again, extremely ketogenic.

So, that's what a fiber does.

So, here's the thing.

There's a ton of protein bars on the market, out there

and a lot of them kind of look like this,

we just went to the Arnold classic, really huge expo.

And if you look, most of them are 15 to 20 g of protein,

20 g of carbs and like, 18 of them are fiber.

So, 20 minus 18 equals 2 net carbs.

So, I just went to my mom this week.

Every time I come to California I have to visit my mom.

If I don't visit my mom, it's not looking good for me.

So, I visited my mom and I showed her like two protein bars

and I'm like "Mom, here's one. Would you eat this?"

she was like "Absolutely, yeah, Jacob, there's only like 2 net carbs, so, yeah."

Now I said "Would you eat this bar?"

She was like "Absolutely, there's only like 3 net carbs in this one."

Now, if you look at the fiber source, the fiber sources differ between these bars.

And the two main ones that you'll see,

one is... on short IMO's, Isomalto oligosaccharides.

Who's heard of those? So, IMO's Isomalto oligosaccharides...

and the other one is... Anyone know?

Soluble corn fiber.

So basically we tested both of these out, to see which was a fiber.

And if indeed was a fiber, do you have a glucose response?

Do you have an insulin response? Is it fermented in the large intestine?

This tells you a lie.

So, here we go soluble corn fiber up against Isomalto oligosaccharides.

So, interesting stuff.

Here are the three criteria we look for.

One, if it's a fiber, you are not going to get a blood glucose response.

Two, if it's a fiber, insulin is not going to raise up.

Three, if it makes it to the large intestine, they'll be fermented.

So, you actually see fermentation and we can measure that.

So what happens?

Here, we're looking. This here, is fermentation.

Is how much the bacteria fermented it.

IMO's?

Did it get fermented?

Not really.

So it's not making it to the large intestine.

Soluble corn fiber? Yes.

It's making it into the large intestine.

Okay. Blood glucose.

IMO's, what's going on? It's going up.

So, what's going on with insulin?

Same thing.

Soluble corn fiber, nothing, no response.

In this case I would say, count net carbs.

In this case where my mom would have eaten that protein bar,

that's what would have happened. Okay?

My point is that, I think net carbs are great if it's actually a fiber source.

So, you got to do your homework on these things.

So what's the future hold?

There's so much it holds, because there's like working like 24/7

and it's a lot of work.

And even when we are here, our guys at the lab are working really, really, really hard,

to try and answer a lot of questions.

And at first I had like 100 slides and Ryan said,

"Doc, you got to cut that down at about, like, 60 slides." So--

But this is one thing is think it's really cool...

We're doing a lifelong study

and this is in rats, with Mike Roberts

and this is the amount of weeks it's gone so far.

Next year's Low-carb Conference we'll tell you what happens

when you eat keto like your whole life. Cool, right?

But this is therapeutic, we're not talking about the keto diets where like you look,

and you look at the diet and like, "Oh, what happened to gut bacteria?"

Well, yeah, you had 5% carbs and none of it was fiber.

That's called the not well formulated ketogenic diet you gave those rats.

So we are doing a well formulated ketogenic diet.

So, anyway, if you look here, this is the carb diet

and then this is the ketogenic diet

and that's ketogenic diet, with exogenous ketones so far,

that's just body weight.

Obviously, we are going to have to look a lot further at what's going on,

but that's the future and that's why is the low-carb USA next year.

Jordan Joy is doing research right now,

looking at the carbohydrate threshold in athletes.

If you're an athlete, due to recommendations change,

can your carbohydrates be a little higher

and you still get all the therapeutic effects and stay in ketosis?

You know, if you look at Peter Attia's work,

he's showing that, that might possibly be case.

But what is that? He's going to try and create an equation

based on a lot of a data he is collecting.

So, that's next year.

Guys, I want to leave you with a quote. Right?

Because all persons in this room really have a lot of work to do,

and I've always said that this is a beautiful quote. Right?

"If not us then who?" and "If not now then when?"

Right?

Thanks guys.

Thank you.

And you guys are doing it,

you are doing it here today and I'm pumped up about that.

So, let's change the world. Thank you.