How Overhydration and Carb Intake Impact Athletes
A Special Interview With Dr. Tim Noakes
By Dr. Joseph Mercola

Dr. Joseph Mercola:

Welcome everyone. Dr. Mercola, helping you take control of your health. And today we are joined by Dr. Tim Noakes and some of you may be aware of his previous work, but he is a physician and a researcher in South Africa. He essentially graduated medical school from Cape Town in South Africa before I graduated college in 1974. And then he got his research degree, I think, a few years later, and he has an extensive history of publishing in science and sports medicine physiology. So, I think he's published over 750 papers, which is absolutely astonishing. It's really first-rate. And he's published two books. One was his breakthrough book and really puts him as a pioneer in this field, [and] is preventing so many people from dying from overhydration and helping correct that issue. It could clear up the massive confusion that existed before he wrote his book. So, we'll talk to him a little bit about that and get a little history, and then we're going to go into some of the low-carb diet approach. So, welcome and thank you for joining us, Dr. Noakes.

Dr. Tim Noakes:

My privilege to be with you. Thank you so much for inviting me. It's a real privilege and I appreciate it.

Dr. Joseph Mercola:

All right, well, thank you for those words. I'm wondering if you could just provide a background as to your shifting from medicine into research, and how that occurred, and what you've been doing, and what your research focuses on or has been.

Dr. Tim Noakes:

So, I think the first thing that happened was as soon as I went to university, I started participating in endurance exercise, particularly rowing, and then I started running. And I became more interested in sport than in medicine. And so, when I was training as a medical doctor, I was much more interested in how would I apply this information to sport and to medicine. And so, when I graduated and then did my internship, I realized I wasn't really cut out to care for patients on a daily basis. I was much more interested to understand why are people sick or why are people healthy, and to do the science. So, I would rather write the book than read the book and learn it, because I can remember stuff, but it has to mean something to me. If it doesn't mean something to me, I can't remember it. And that was the problem because medicine is such a lot of pressure to learn a lot of stuff that you probably will never use.

So, I went into research and it was fortunate that I became involved with Professor Lionel Opie, who was just very, very helpful to me, very supportive, and we had built a great relationship. I worked with him for five years and at the end of that time, I was asked to start sports science and

sports medicine at my university. That was now 1981, which I did. And then I started writing more and doing more research, and we built up a research background. We became a pretty good group of researchers. Unfortunately, we researched the wrong thing. We studied carbohydrates and exercise performance, and I now realize that probably wasn't the best thing to be studying. But anyway, I learned how to do science. And as you've indicated, I did it pretty effectively.

So, I went on like this and I was the golden boy of my university, literally, and in fact of South African scientists, I was the golden boy. And I could never do anything wrong until one day I read a book called "The New Atkins for the New You," and realized that I got my dietary advice completely wrong and that I was unhealthy on the basis of what I was advising myself to eat and others to eat. And within a period of two hours, I decided to change my diet and try this new thing with [a] high fat, low carbohydrate diet and had spectacular results, and ultimately discovered I was a Type 2 diabetic and I put that into remission. And then the next thing of interest was I joined Twitter and then I did this one very famous Twitter tweet, which caused me to be charged by the medical profession in South Africa for unprofessional behavior.

Had to go to court for four years, 28 days over four years. Eventually won the case and proved that the low carbohydrate diet has got plenty of evidence behind it. It's not unscientific, it's in fact the most scientifically studied diet in the world. So, I won that case, which cleared my name because they tried to completely publicly humiliate me. That was my university and my profession. Fortunately, it came at the end of my career. So, I've had time to prepare for the trial and do a really good job and had some brilliant lawyers. So, we won that case and at the same time I was asked to start helping some other people with research, and we started delving deeper in doing studies that I hadn't done before on low carbohydrate diets. And essentially, we're on the cusp of proving that humans don't need carbohydrates. Everyone knows that, but when you come from an athletic background, you can't believe that.

Well, we've taken it to the extreme and we've shown that athletes eating a high-fat diet, their performance is perfect, it's completely normal. And so, my opinion is, the dietary macronutrient composition, the amount of carbohydrate and amount of fat you're eating, has no effect on your athletic performance, with one exception, which we might just talk about. But the reason you burn carbohydrates is very clear to me. You burn carbohydrates to regulate your blood glucose concentration. That's the key element of metabolism, is to regulate your blood glucose. And because humans evolved on a high-fat, high-protein diet, we never had the capacity. We didn't have a need to regulate the blood glucose concentration because we weren't eating stuff that was raising it.

Then all of a sudden, as you know, in the last 50 years or so, we've started eating more and more carbohydrates. And so, you've got this problem of our biology [that] is not designed to cope with all this carbohydrate. And the way we cope with it is we try to burn it immediately. It comes into the body, you try and burn it and get rid of it out of the bloodstream. And that's why, when we study athletes who are eating [a] high carbohydrate diet, we always say, "Well, you see they're burning so much carbohydrate, but they're burning it to get rid of it, not because they need to use it." And we are the first people in a hundred years to show that fat-adapted athletes can burn fat at very high rates in high-intensity exercise to the point where you could run a two-hour marathon burning fat alone. That's what the data suggests.

We haven't had a person run a two-hour marathon on a high-fat diet, but the amount of energy required by Eliud Kipchoge when he runs a sub-two-hour marathon is about 80 kilojoules per minute. Fat can provide 76 kilojoules per minute at least. So, he could run all that race just burning fat, which of course conflicts with everything we're taught. So that's where we're at, at the moment. And I'm working vigorously on finalizing the documents, which prove that humans don't need carbohydrates for exercise. They can do very well with a minimum amount of carbohydrate.

Dr. Joseph Mercola:

Well, thank you for sharing that background. I'd like to go into more detail about a topic that you didn't mention, which, I believe, is probably one of your greatest contributions to science, and that is helping us understand the dangers of overhydration that has killed so many people in long-distance endurance events, where they attempted to compensate for being dehydrated and wound up killing themselves secondary to hyponatremia and heart arrhythmias. So maybe you can share with us your process of coming to that conclusion and popularizing the correct approach to hydration during long-distance endurance events.

Dr. Tim Noakes:

So, I mentioned 1981 was when I first started and I'm now a lecturer in sports science at the University of Cape Town. And I'm giving my conventional lectures – and in fact I wrote an article March 1981 saying, "Runners must drink as much as they possibly can tolerate when they're running, and what doesn't go in your mouth must go over your body to keep you cool because heat stroke's the worst possible thing that can affect you during marathon running." And I'd been pushing that story for about 10 years. And the reason was because when I first started running marathons in 1973, we weren't allowed to drink or we were almost forbidden to drink. And the rule slowly changed and then it was realized that it wasn't a good idea not to drink. Anyway, so [in] March, I write this article, and then on about June 7th of that year, I get an email – sorry, it was a letter in those days, through the post from a lady who'd competed in South Africa's most iconic race.

It's a 56-mile race up and down hills between two cities in KwaZulu-Natal. It's been running since 1921, and it is probably the greatest race in the world for a number of reasons. It's just an astonishing race. So, she's running in this 56-mile race. Now, to get into the race she has to qualify, so she has to have done a decent marathon time to get into the race. So, she's pretty fit. So, she runs the race and it's 70 kilometers into the race. She doesn't recognize her husband who's supporting her. And he figures there's something wrong with her. So, he says, "I'm taking you out of the race." And he puts her in the car and he drives her to the finish of the race. And she's examined there by the doctors who say, "Oh, you see, you're dehydrated, you need more fluids." So she's given 2 liters of fluid intravenously, and she goes unconscious.

And the guy, the husband says, "Your treatment's not making her better, it's making her worse. I'm going to take her somewhere else." So, he puts her in the car and takes her back to where the start of the race was where he admits her to hospital, but in the process, she has an epileptic seizure at the same time. So, he arrives in Durban with his wife six or seven hours later, who was perfectly healthy when she started the race. She's now unconscious, so she's admitted. And

fortunately, she was seen by a well-trained physician who knows that when you have an unconscious patient, [there are] a lot of things you have to do. And one of them is to measure the blood sodium concentration. And he found her with 112 units and 140, as you know, is the normal. And so, he didn't know how to treat her, but he didn't treat her wrongly. He didn't treat her rightly, but he didn't treat her wrongly.

Had he given her fluids, he would've killed her. There's no question. So, he restricted fluids and just waited. And over four days she eventually became conscious. She took four days to regain consciousness. So, she wrote to me and she said "What had happened?" She'd been told she'd lost a lot of salt in diarrhea or something, and that was the problem. And I said to her, "Well, I have no idea because this is the first case ever reported." And then obviously I was interested to find out. So, I started phoning around and studying it. Turned out there was another athlete who'd suffered a similar problem in the same race, and I got evidence about him. And then I found another two cases. So, by 1985, I had four cases and it was clear to me that all had drunk too much fluid during the race. I couldn't prove it because it was only on their history-

Dr. Joseph Mercola:

Can I interrupt you for a moment?

Dr. Tim Noakes:

Sure.

Dr. Joseph Mercola:

When they gave the woman fluid at the finish line, I think you said 2 liters, was that water or was it normal saline?

Dr. Tim Noakes:

Normal saline.

Dr. Joseph Mercola:

They gave her normal saline that still caused it. Wow.

Dr. Tim Noakes:

Yeah. Normal saline will kill you at that.

Dr. Joseph Mercola:

Wow.

Dr. Tim Noakes:

The treatment is you have to give 3% to 5% sodium, and then what happens is the kidneys can no longer concentrate that. And so, they just release the sodium that you've injected in and it

takes out water and it's miraculous. We've had some dramatic recoveries, people going from unconscious to fully conscious in a couple of hours and other people in minutes. Literally in minutes, being completely confused, and you give them this high sodium and within minutes they start to get better. And the reason is because as the sodium drops, the fluid expands the brain, and so the brain volume starts to increase and ultimately the pressure rises. So it stops the blood [from] flowing in or flowing out, and as a consequence, the back of the brain goes right through to below the spinal cord and it crushes it, and then you stop breathing. So that's the cause of death, you stop breathing.

And so that's the problem and that's how it happened. So, during that time – and in fact, it was about a few years later, I was phoned at midnight, and I think it was 1986 – and now, we've written a paper published 1985 saying we think it's fluid overload. Then in 1986, at midnight, I'm phoned from the race itself. I wasn't participating that year. And the doctor says, "I've got seven patients with low sodium and they're all in real distress." And she said, "What do I do?" I said, "All I know is you just give them a diuretic and don't give them fluids." And they fortunately survived. So, I decided next year we'd go up to the Comrades Marathon. I sent a Ph.D. student to study patients who were hospitalized with this condition and he did a brilliant study.

He followed them in recovery. He measured how much sodium they lost in the urine, how much water they lost, and how much sodium was given to them. And concluded without any doubt that all had been overhydrated. And for some, it was up to 6 liters. And I'm not quite sure what a pint is, but this is a lot of – That's 6 kilograms of water in excess [that] they had drunk during the race. So then we knew, [and] we published that paper in the Journal of Applied Physiology and it showed that this was a condition of fluid overload. Now, at that very time, the problem was that the sports drink industry in the United States was taking off, and they were telling runners in America to drink as much as tolerable, and we knew that's going to kill patients. And I predicted that the first person who would die from this condition would be a female runner in [an] American race. And that exactly happened. In 1993, a runner in California died.

And again, she finished the race, she was semi-conscious, and then she was treated, and the treatment was wrong. And that unfortunately led to her demise. So ultimately, we were able to prove that the condition doesn't occur in everyone who overdrinks. Most people who overdrink simply pass more urine. So, they're running along and they're drinking too much and they pass all this urine. They say, "Well, actually I probably don't need to drink all this amount." What happens in this condition is that they've got inappropriate hormone secretion, antidiuretic hormone. And they retain fluid, even though they're overhydrated, they retain fluid. And so, they're running along and they're not passing urine, so they think, "My gosh, I'm dehydrated, so I must drink more." And that fluid is retained because this hormone is so powerful at retaining water. And so ultimately the brain swells, they lose consciousness. And provided you leave them alone or give them a solid high-sodium infusion, they're fine. But if you give them a low-sodium infusion, you're going to kill them. That's what will happen. And that, as you've indicated, did happen.

So, I was demonized for saying all this. Eventually I wrote that book, "Waterlogged," which I have – yeah, here it is. So eventually I wrote this book "Waterlogged," and that describes the whole history of what happened and the whole story of how you should just drink to thirst. And dehydration has never been shown to be a cause of ill health or death in marathon runners. How

could it be? Where do you find more fluid available to humans than during a marathon race? Nowhere. So how can these people not be drinking and be dehydrated? It doesn't make sense.

Dr. Joseph Mercola:

Congratulations on that discovery. Now, you were the first researcher that identified this syndrome, and you're responsible for-

Dr. Tim Noakes:

That's correct.

Dr. Joseph Mercola:

Yeah. So, in my view, that discovery should warrant a Nobel Prize in physiology and medicine, because it's truly profound. It's going to save so many lives and it's foundational — something that was not known prior to your discovery. So, congratulations.

Dr. Tim Noakes:

Thank you very much. I'm very touched by that. That's so kind of you. When someone else says that, it really means a lot to me. So thanks, Dr. Mercola, I really appreciate that.

Dr. Joseph Mercola:

It is clearly an outstanding treatment. I'm personally curious what is responsible for the initiation of the increase in ADH or antidiuretic hormone? What would cause them to do that?

Dr. Tim Noakes:

I think it's genetic in the sense that you either have it or you don't. And I think about 10% to 20% of people have that condition that when they overdrink, the body doesn't recognize it as being overhydrated, it still thinks you're dehydrated. So that's the closest I can come. It is true that if you have pain and discomfort and so on, that can cause ADH to rise even though you're becoming overhydrated, but I can't see that. We have so many people running marathons and getting sore, but they're all not showing SIADH (syndrome of inappropriate antidiuretic hormone release). So, I don't think it's that. I think there's a problem, a biological problem in these people, and we see it every so often. In fact, last week I think I was reading about a woman who killed herself by doing one of these contests, how much can you drink in 24 hours? And so, there wasn't any pain involved. She just has this condition, and if you're going to drink to excess, that's going to be the outcome.

Dr. Joseph Mercola:

Yeah, so maybe they have a genetic SNP (single nucleotide polymorphism) or polymorphism that facilitates that. Interesting. So, I also want to congratulate you on really standing up to the censorship that was pre-COVID. You did that, what? Almost eight years, six years before the COVID censorship. So, we have many similarities in our background. We both went – except

I'm not a researcher, I just went into clinical practice, but you went on to become a world-class researcher. But we both embraced endurance running long before it became popular. I started in ‘68 and I haven't run as many races as you, at least long-distance races, but I also embraced low-carb early on, probably before you did.

Dr. Tim Noakes:

Yes.

Dr. Joseph Mercola:

And I wrote a book called “Fat for Fuel.” So, I really get the concept, endorsed it, recommended it, and I'm sure millions of people I catalyzed, they're following it. But I never got diabetes. I think because I was embracing the low-carb [diet]. So, I think that there's great value in low-carb. [There’s] not a microdot in my mind that so many people benefit from it. And I think it's largely related to the fact that a massive percentage of the population, the vast majority – There was a paper published last July, which is the most recent data from the 2018 NHANES (National Health and Nutrition Examination Survey) data, that showed that 93%, 14 out of 15 people, were metabolically inflexible, insulin-resistant. And this was in U.S. data, and that data was 2018. That is 5-year-old data now. So, I think it's 95% to 97%. And my guess is that virtually every single one of those individuals would significantly benefit from a low-carb approach to facilitate their ability to recover metabolic flexibility.

But here's where I diverge, and this is a recent divergence. You might have heard of some of the work of Ray Peat, he was a biologist, he passed away last year. But he took a converse approach with respect to advocating a relatively high-glucose diet. But specific types of carbs, not all carbs, very specific types that can facilitate optimal health. And it's called bioenergetic medicine. And there's many people who follow him, and interestingly, a lot of people who follow his work have done really, really well. And I was always wondering when I was low-carb too, “Why was it that these low-fat people did so well?” Not all of them, but they did. Because there were two ways you could treat diabetes that were highly successful: low-fat, high-carb or high-fat, low-carb. They both seem to work.

I think there's many commonalities between them, a lot of them being that they were based on more of a whole food diet. So, a lot of the processed foods were being avoided. And I think that is probably the most pernicious contributor to ill health, [it’s] processed foods. And the single most important variable in those processed foods from my understanding is the omega-6 excess that we have, and specifically, linoleic acid (LA). So, you stated earlier that you're on the verge of proving that we don't need – and I want to make sure that I'm saying this correctly because the words are important – that we don't need carbohydrates to compete effectively in endurance events. Is that it or did I mischaracterize-

Dr. Tim Noakes:

No, I think that's the safest comment to make. Yes.

Dr. Joseph Mercola:

Okay. Okay. So, I think that's probably true, but the reason I went into medicine was I have a passion to be healthy, to live as long and healthy as I can and teach other people how to do that. So, in that effort, I concluded up until recently that fat was the ideal fuel to burn as a substrate in your mitochondria. And I've encountered information primarily through Ray Peat's work that suggests that's not true. And that although technically you don't need carbohydrates, your body can make it, but it makes it at a price. And this is what I want to discuss with you because you're really the almost ideal person.

You're such a well-respected and deeply knowledgeable researcher. You're intimately familiar with the science, and I just never had been able to have a dialogue with someone with your stature in this important area of molecular biology. So, I'm just so delighted to engage in this conversation. But the supposition is that what is the ideal fuel to burn in the mitochondria to optimize longevity? And to do that, you have to minimize – well, rather than taking it from a negative perspective, [the] positive perspective is you have to optimize mitochondrial efficiency. And that is, produce fuel with the least amount of exhaust in the form of reactive oxygen species. So, my understanding is that you can do that if you have forward electron flow in the mitochondria through the complexes and you can get to 99.9% efficiency.

But when you encounter something, I suspect you're familiar with this, reductive stress, which facilitates reverse electron flow in the mitochondria, then the amount of reactive oxygen species that are generated goes up 30 to 40 times. It's still only 3% to 4%, but that's a big jump. And one of the things that can contribute to this reductive stress is beta-oxidation of fat that contributes to the acetyl-CoA (acetyl coenzyme A) that's fed into the chain. And when beta-oxidation occurs, my understanding is that the electrons don't jump to complex I, they're jumping to complex II, and that's contributing to some of that reductive stress. And that reductive stress from the fatty acids – and of course, linoleic acid being the worst, but even saturated fatty acids – is going to fuel you and fuel you in a way that is better than 95% of the population. But the question in my mind, is it optimal? Is that what we're really designed for? And the danger – let me just continue and I'll let you-

Dr. Tim Noakes:

Yeah. Sure.

Dr. Joseph Mercola:

-go on as long as you'd like, because there's another point I want to bring in. The danger and the concern that really shocked me – I almost fell down when I heard this. Because everyone who goes to medical school knows about cortisol, and we're taught that it's a glucocorticoid. Well, think about that for a minute, but its first word is gluco. It's responsible for glucose homeostasis. And if you look it up in the books, that's what they tell you, it normalizes glucose. But it does it in its very peculiar way. It's the rescue hormone that when our glucose levels get too low, you're going to secrete cortisol. And the danger of that is that – it definitely works, thank God we have it. We'd be dead in a heartbeat without it because you have to have this ability to generate glucose instantly in a flight or fright reaction.

But if you do it chronically, the cortisol essentially shreds your important tissues, like your bones, your brain [and] your muscles. It sacrifices and liberates – well, it liberates fatty acids, too – but it liberates amino acids from these tissues and essentially sacrifices and shuttles them to the liver for gluconeogenesis to generate glucose, thank God. So, the danger of going low-carb long-term – as I said, I totally agree that [for] short-term, it's a magnificent intervention – but long-term is that you tend to have this chronic excess cortisol, which leads to a lot of complications, specifically some of the sarcopenia, especially in the elderly. So those are the concerns I have adopted, I guess, in the last year or two as I've been studying Ray Peat's work. And examining the science, it seems to support it. And I'm just so interested in getting your take on this perceived anomaly.

Dr. Tim Noakes:

So, let me tell you the story. So, when I went into research – I mentioned Lionel Opie's name – and I studied the pumping heart, the isolated heart of the rat. We would take the rats, we'd mount the heart on a circulating system, so it was working as if it was in the body of the rat. And my focus for my Ph.D. was to [know] what were the fuels that made the heart perform the best? And I came to the conclusion that glucose and insulin were actually the optimum, but the very first experiment I did was to add ketones to glucose and the heart functioned a lot better, but I left it at that and didn't deal with it any further, unfortunately, because Dr. Richard Veech-

Dr. Joseph Mercola:

Oh sure, he passed away two or three years ago. Yeah.

Dr. Tim Noakes:

That's right. He did exactly the same experiments 10 years later or so and came to the conclusion that ketone metabolism was crucial for whole body metabolism. And if I read the introduction to this article, "Therapeutic potentials of mild ketosis flow directly from a thorough understanding of their metabolic effects, particularly upon mitochondrial redox states and energetics, and upon substrate availability." Now, it turns out that Lionel Opie had worked in the same laboratory before Dr. Veech arrived. And when Dr. Veech arrived, the boss of the laboratory [is] Hans Krebs, who won the Nobel Prize, and he was inspired by [Otto] Warburg to leave Germany and go to Cambridge and Oxford to study and then produce the Krebs cycle. When Dr. Veech came along, he said, "I want to understand the redox state of tissues." And that was the challenge that he put to Dr. Richard Veech. And there's a lovely book, "Ketones, The Fourth Fuel," written by Travis Christofferson, in which he talks about Warburg to Hans Krebs to Dr. Veech.

And they were the three people who really promoted ketone metabolism and its understanding. So, I'm not the authority, but it seems to me that ketones do have a special role in mitochondrial metabolism and to do exactly what you're suggesting the carbohydrates do. So that's an interesting story, and I think that one needs to go and study more why Dr. Veech became so famous and what was Krebs asking? Why was he asking that question? "I want to know the total cell redox state," and not just the ATP (adenosine triphosphate) [to] ADP (adenosine diphosphate) ratio [or] NAD (nicotinamide adenine dinucleotide) NADH (reduced nicotinamide adenine dinucleotide) ratio. He wanted to know the whole story, and that was the challenge he

gave to Dr. Veech. And Dr. Veech came to the conclusion that ketones had a special role in minimizing mitochondrial electron overflow, as you suggested, and oxidative stress. But I haven't really studied closely enough all his research, and that's why I've got this paper right here waiting to be read.

Dr. Joseph Mercola:

All right, well, fair enough. But you had mentioned your studies in cardiac cells – and those cells are a bit different than most cells in the body in that in a resting state, they require fat to fuel their function, and if they don't get it, it's a problem. So, I'm not saying you need a 0% fat diet — that would kill you for sure. And the heart cells are an anomaly because that's not true for most of the other cells in the body. So, I'm not sure if it's fair to use that as a state, but I think you're right that with respect to optimizing redox potential it's really the key. And I'm wondering if you'd explored some of the really important cofactors in mitochondrial energy production and one of the biggest ones is NAD+. And that, of course, has become quite popular nowadays with NAD precursors.

The big ones would be nicotinamide riboside (NR) and then nicotinamide mononucleotide (NMN), which are the expensive ones. Typically $100 or many hundreds of dollars a month, if you're going to use them in bigger doses. But NMN is not available. It was just taken off the market because there was a company making NMN and seeking to get it as a drug, so they convinced the FDA (Food and Drug Administration) to make it illegal. So, there's just NR and what I think is the optimal, or really, the ideal form, which is niacinamide, at a small dose [of] about 50 milligrams three times a day. But anyway, the reason that's important is that if you have – there seems to be a correlation, a direct correlation, between the NAD level or concentrations and the level of ATP being produced. So, if you can optimize or maximize your NAD production, you're likely going to have a corresponding increase in ATP. And I'm wondering if you looked or explored that issue at all?

Dr. Tim Noakes:

No, I haven't. Because I'm not a cellular biologist and such, I'm a macro whole-body biologist, and so I followed what came out on the role of the high-fat diet and the fact that humans evolved with that diet. And I must admit that if you'd asked me 10 years ago, I would've said that supplements play no role in health [inaudible 00:33:47]. And let's face it, that is still the general opinion of medical doctors or that's what we're taught at medical school, and I've significantly changed that. I have an array of substances which I take, but I'm looking for the evidence that they do make a difference. And I understand that that evidence is really difficult to get, so I try to go from the evidence rather than the model. And I understand why people start with a model and they say, "This predicts that's what you should be doing." But I tend to go the other way. I go from the evidence and then try to explain that evidence with a model. So that's what I'm looking for.

Dr. Joseph Mercola:

That's the way you figured out the overhydration for sure.

Dr. Tim Noakes:

Yeah.

Dr. Joseph Mercola:

You worked backwards.

Dr. Tim Noakes:

And it's the same that the model – a lot of people, their model is carbohydrates are essential for exercise. So, then they argue everything like that. "Oh, you see, we give these people carbohydrates and they perform better. So that proves the carbohydrates are the real deal." Or they look at the evidence and they say, "Oh, but we gave more carbohydrates and performance almost changed, but it didn't quite change. But we know that the model is such that they must change, so therefore our research was incomplete." When what you [should] do is, if you do an experiment and it doesn't prove or support what you believe, your belief's wrong. And I'm just at this very moment involved in a debate, which will be published in Medicine and Science in Sports and Exercise, and one of the people has been promoting the high carbohydrate diet for the last 30 years and that person's – the model is fixed in the head and there's never a desire to study anything else.

Dr. Joseph Mercola:

Can you disclose who that person is?

Dr. Tim Noakes:

No, I don't think it's fair at this time.

Dr. Joseph Mercola:

Okay. Okay. All right.

Dr. Tim Noakes:

That will become apparent when the journal is published in a few months' time. But the point is that the model is so fixed and [in] science, you must test your model. And that's what I've done all my career, look for the outliers like this lady who was supposedly dehydrated when she was overhydrated and very soon realizing that overhydration was the real problem. But unfortunately, some people could never get around that. And some very important organizers of marathons could never get around the idea that dehydration wasn't the real problem. And it's the same here. If you believe carbs are essential, then you'll ignore all the evidence. And in these debates you have with people, they'll say, "Oh, it didn't work, but it should have worked. But it would've worked if we'd done this." No, no, no. That's not how science works.

You design the experiment and you see what the outcome is, and if it disagrees with your hypothesis, [then] your hypothesis is wrong. Richard Feynman said that so many years ago, "If the experiment doesn't agree with you, you're wrong, not the experiment." And so, at the moment, we're just gearing up for the ultimate test to see how much carbohydrate you actually

need during exercise, and our hypothesis is that it's a trivial amount. All you need is just to maintain your blood glucose concentration. That's all you need to do. And your blood glucose concentration is under stress during exercise because even if you're fully fat-adapted, you can't quite generate enough glucose to maintain your blood glucose for more than about three or four hours. So ultimately, if you don't have carbs and if you're a low-carb athlete, you don't eat any carbs, after about four hours you [will] run into trouble. And so, we are testing that hypothesis. It's not the maximum amount of carbohydrates you need. We want to determine the minimum, as much as we determine the minimum amount of fluids you need during exercise.

Dr. Joseph Mercola:

Okay, so you're in the process of doing that research now?

Dr. Tim Noakes:

Yes. And hopefully by December we'll happily – the results will be in. We designed what I think is the perfect study, and it's going to prove us wrong or it's going to prove us, which is the best-

Dr. Joseph Mercola:

I would love to see that study, but in my experience, one of the primary compounding variables that's very rarely addressed – and it may or may not be addressed in your case, but it certainly isn't addressed in almost all the discussions with the low-carb versus high-carb. And the quantities of the carb in my mind varies in ideal. And my focus again is really on human health and longevity, not necessarily athletic performance. So, it's a bit of a different focus, but you just can't willy-nilly throw high-carbs on someone. It has to do – are you familiar with the Randle cycle?

Dr. Tim Noakes:

Yes.

Dr. Joseph Mercola:

You would be, of course, you're a good researcher.

Dr. Tim Noakes:

Well, Randle also came from-

Dr. Joseph Mercola:

Was he South African?

Dr. Tim Noakes:

No, no, no. He's British. And the Randle – that's what I was taught, because I was studying the heart, and the Randle effect is why when you give fatty acids, you inhibit glucose uptake and so

on, which turns out isn't true in the heart anymore, but it was in his experiments that looked like it was true.

Dr. Joseph Mercola:

Yeah, again, the heart or the cardiac cells are [an] anomaly because they have to run continuously. But generally, I think most scientists and certainly people in the keto community don't appreciate the Randle effect. And it's really one of the limiting factors where you just can't throw high-carbs if you're taking a lot of fat. The Randle cycle is going to inhibit the oxidation of glucose in the mitochondria, and that's not – So you have to consolidate that Randle effect and optimize your fat intake. And if you're metabolically impaired as many people are, that fat intake might need to go as low as 10% [or] 15%, not long-term but short-term, before you can force the glucose to be oxidized in the mitochondria rather than be shuttled over to glycolysis. But I want to propose this confounding variable I referenced earlier, as I believe what would probably, more than likely, the reason why you developed diabetes wasn't because you were high-carb.

The carb is an innocent victim in this process, I believe. I think the real culprit is the enormous amount of omega-6 that you had accumulated because you really – it sounds like you weren't really optimized on an optimal healthy diet. It's important to eat, and you didn't eat really junk food and stuff, but almost – unless you're obsessive about focusing – or almost orthorexic. I'm focusing on this linoleic acid, it's really hard not to have unhealthy tissue levels.

Dr. Tim Noakes:

I agree.

Dr. Joseph Mercola:

What's a healthy tissue level? Probably under 2%. And humanity hasn't seen that for 150 years, when they first started industrial processing shortly after the Civil War in the United States about the 1860s [or] 1870s. Then, the fat content of the diet was almost exclusively due to animals, it was 99%. Now, it's 80%, these vegetable or seed oils, 80%. And we have levels in our tissues that are 12 times higher than optimal, 12 times higher, literally. And that's such a significant issue because it's so susceptible to oxidative damage and it liberates these oxidative metabolites like acrolein, malondialdehyde, 4-hydroxynonenal, and these damage the tissues, specifically the mitochondria. When it gets embedded in cardiolipin, oh my gosh, it's off to the races and mitochondrial destruction.

And then it becomes really a challenge to oxidize glucose in the mitochondria if you've got this oxidative damage and you've got high levels of fatty acids in tissues and high levels of lipolysis that are circulating in the fatty acids. So, I think that's the variable. I think that's the issue that really needs to be addressed foundationally to decipher what's really going on. And unless you look at the LA levels – and I'm really curious as to in your study, I'm assuming it's an animal model and you're feeding them conventional rat chow or mice chow?

Dr. Tim Noakes:

Sorry. So, now the studies we're doing are on humans. But let me just add a point there. The last study we did was of high-fat diet, high-carb diet in 10 athletes, randomized controlled crossover. And what was really interesting [is] we also measured continuous glucose monitoring on these athletes. Now these athletes are lean. They're not the world's best athletes, but they're good runners. They run 5 kilometers in about 20 minutes so they can run [inaudible 00:43:08]. So, they're not slow, but they're not Eliud Kipchoge, which is – even though, if you're not studying Eliud Kipchoge, you're not studying physiology. It's pathetic. And anyway, of the 10 on the high-carb diet, three became pre-diabetic. They showed clear evidence for pre-diabetes, and these are healthy people. As soon as they went on the high-fat diet, they reversed that and they'll be completely normalized. And the interesting point was, to come back to your message, they were the big fat burners.

The ones who had the highest rates of fat oxidation were the ones who benefited the most from the high-fat diet. Anyway, but to come back to your point that they changed their diet, [the] only thing that we claim they changed was eating a low-carb diet, but of course it wasn't. They ate a much better, healthier diet and they probably cut out a lot of the vegetable oils that you spoke about. So, I quite agree with you, we can't exclude the fact that the benefit of the low-carb diet in them was not because they just began to eat a better healthier diet. And when you look at the diets – I've looked at world-class triathletes who've asked me for dietary advice, and they're eating a lot of calories, but so much of it is junk. It's too terrible. When you go on this athletic high-carb diet, ultraprocessed food diet, it's a profoundly unhealthy diet. And I suspect there's a lot of vegetable oils, omega-6s in that diet as well.

Dr. Joseph Mercola:

Yeah, I think that's the culprit. And I think, unless you're controlling for that variable, the results of the study are going to be difficult to interpret. That's being kind, I think. Because in my view – and I've just wrote a paper, I've got two papers written this century – you've probably got 400 – but it's a narrative review of linoleic acid, and historically what's been happening and why, and provides the scientific understanding as to why it's such a big issue. But I think that's the issue. And there's no question, [a] high-carb diet and the conventional application of that is probably terrible. But if you control for the fat, minimize linoleic acid and get the total fat content under 30% - you really can't go high-carb unless you're relatively lower fat because it's exactly predictable. You can lead to diabetes, especially [if] you have high tissue levels of linoleic acid, that glucose cannot be metabolized in mitochondria. It's going to go right to glycolysis, it's going [to] generate lactate, mess up the redox potential, and it just puts everything in the wrong direction.

In the bioenergetic community's view, diabetes and obesity, for that matter – this is a good point, you can be obese, massively obese, and not be diabetic. They're not one and one. They're frequently accompanied, but of course, you know they are not – so, there are whole populations that are obese but essentially have very low levels of fat burning into their mitochondria and they're not diabetic. So, the bioenergetic community's view is that it's really a fat-burning issue, and that's excess fat in the tissues and excess lipolysis that's causing the mitochondrial disruption to not allow the glucose to be optimally metabolized in the mitochondria like it was designed to and generate in a forward electron flow the minimum amount of reactive oxygen species. So, it's

not a simple throw out any carbohydrate on board and you're going to be a problem, especially if you're throwing grains on, which are full of linoleic acid and a lot of resistant starches.

So ideally you have the right amount, not excess, the right amount of carbohydrates in the form of ripe fruits, which is probably one of the best foods in the world, I think. Ripe fruits, because it's loaded with typical high levels of potassium, which will balance any sodium. Oh, that's another question. I'll let you respond to that. But getting back to the overhydration, I'm wondering from your extensive – you're world-class expert – what is your view on the use of baking soda as a supplement to prevent dehydration? Typically, in the levels – because I know it's being used quite a bit as a neurogenic aid for sports, and actually I think it's illegal, if I'm not mistaken, to use this as an aid in horse racing. They've mandated it illegal because it provides such a competitive advantage. But on the dose of probably a teaspoon, 5 grams, three times or four times a day, to not only neutralize the acidity but also raise sodium levels and CO2.

Dr. Tim Noakes:

Yeah. So, we did some studies years ago and I'd have to go and look at them again, and I wasn't very convinced that there was benefit in terms of – there were also side effects, [like] diarrhea, et cetera. So, I'm very reluctant to fool around with the system and rather train it properly and get it properly adapted. I'm again looking at articles on teaching the gut to take more glucose in. To me, that's ridiculous. The cause of abdominal distress during exercise is usually too much carbohydrates. So now what these people pushing carbs will say, "Oh yes, but if you can train the gut, then it's not a problem." But it seems to me that that's wrong. There's a reason why if you're getting sick when you're taking the product, then it's probably not such a good idea.

Dr. Joseph Mercola:

And you're referring to taking the glucose during the competition?

Dr. Tim Noakes:

Yeah, yeah. I'm talking about 120 grams an hour, 120-

Dr. Joseph Mercola:

Oh man, that's massive.

Dr. Tim Noakes:

And I tell people, "But that's two glucose tolerance tests every hour." We use a glucose tolerance test to prove that you're unhealthy, not to prove that you're healthy. It's astonishing. And actually, this is the model. They've used this model, and somewhere they managed to get people taking 90 grams who would perform slightly better, marginally better. So, if you've got 90 grams, what about 120 grams? "Oh, the 120 grams is no better than the 90, so we'll stick between 90 and 120 grams an hour." And that's just ludicrous, because if you look at the metabolism, what that does is completely shuts off fat metabolism. So, these people are running with not burning any fat, they're just burning the carbs to try to get rid of it as I've indicated. There's one point I would like to make because one of the best studies we did in 1999, and one that I only realized years later

how important that was, was that muscle glycogen determines fat metabolism. It's not the Randle cycle, it's the content of glycogen in the muscles [that] determines how much fat you burn.

And we showed that because we made people – we had them glycogen depleted, and then we infused glucose. And then glucose infusion made no difference. They refused to burn the extra glucose because they were burning so much fat when the glycogen was low. And in fact, I found an old paper somewhere again that the best way to normalize your glucose tolerance is to get your muscle glycogen to zero or as low as possible. And that fits my model. My model is that when you take carbohydrate, the first thing you do is you try to burn it. So, you inhibit fat oxidation and then you dump it, you dump it in muscle. That's why muscle is there and that's why liver is there. And now I'm giving you my story. So, you can say it's all wrong, but for people to think about it.

Dr. Joseph Mercola:

No, no, that's where you're expert at for sure.

Dr. Tim Noakes:

It seems to me that you dump it in the muscles and then you've got to exercise to get rid of it, and you see, you cannot stop muscle glycogen burning. You cannot. You can do what you like, it doesn't stop. So, you can infuse glucose at high rates, the muscles will still burn the glycogen. If there's glycogen in the muscle, it will be burned. And you have to ask, "Why? When there's so much fat to be oxidized?" So that's the model that I see. I see the human as being loving to burn fat, and we've destroyed that by feeding them linoleic acid and carbs for too long. That's how I see it.

Dr. Joseph Mercola:

Well, good. My understanding of muscle glycogen is that it's only used in the muscle, that the glycogen can't be secreted into your bloodstream-

Dr. Tim Noakes:

That's correct.

Dr. Joseph Mercola:

Only the glycogen in the liver can do that.

Dr. Tim Noakes:

Yeah, that's correct.

Dr. Joseph Mercola:

So that would be an issue. The two issues I would think of is that, that speaks strongly for resistance training and building up significant muscle mass, which has been my transition out of

endurance running. I've been doing resistance training [for] the last 10 years. And then the other is liver health, which I think two-thirds of the population, primarily related to high tissue levels of linoleic acid, have dysfunctional livers, NAFLD (nonalcoholic fatty liver disease) to NASD (non-apnea sleep disorder).

Dr. Tim Noakes:

Absolutely.

Dr. Joseph Mercola:

Yeah. And if you have liver disease, you're not going to be able to store large amounts of glycogen in your liver. What is your best guess, if someone has NAFLD, how much of a reduced capacity do they have to store glycogen?

Dr. Tim Noakes:

That's a great question. I would love to see someone measure it. I don't know. But if you're filling yourself up with fat-

Dr. Joseph Mercola:

What's your guess?

Dr. Tim Noakes:

Maybe half. Maybe half.

Dr. Joseph Mercola:

Yeah, I would think so. That would be my guess. So, half. So that's a big difference. And the reason that's so important is because – especially if you're on low-carb, I think that's a serious issue that has to be factored in here. If your liver isn't that healthy, you've got half the reduced capacity of storing glycogen in the liver, which is really the only source you have because you can't secrete it, as you confirmed, through the muscles. Either eating it or it's being secreted from the liver. So, you don't have that much of a storage capacity. So, you're going to shift to the cortisol. And I'm wondering, have you looked at the cortisol issue? Because to me, that's a big, big issue. And there are many experts who view cortisol itself as the primary aging hormone, the thing that's going to put the metal to the pedal of rapidly accelerating the aging process is if you have excess cortisol.

Dr. Tim Noakes:

Excellent. And I was going to ask – oh, I was going to ask you a question because I've also shifted to weights and resistance training and it's astonishing. I think when I look back, the benefits I get as a 74-year-old from resistance training are equal to the benefits I used to get at running as a 20-year-old or a 30-year-old, but today at 70, I can't get those benefits from running anymore. You have to change. And I just don't know what's changed. And I've met a lot of

endurance athletes who've told me exactly what you said, that once they crossed their 60s, they reduced the running or the cycling and moved into resistance training and with huge benefits.

Dr. Joseph Mercola:

Yeah, I see. Actually, because I started early – I was young. I started in 1968, my endurance training. And so, I continued for 43 years before I stopped. My body just said, "You cannot do this anymore." I had no injuries, I never injured my knees, I never had one running injury in my entire career. I was never really a great runner. I did a 2:50 marathon and maybe a-

Dr. Tim Noakes:

That's exactly my time, too. So, there we go. We are matched.

Dr. Joseph Mercola:

Yeah, so I told you there's a lot of similarities in our past, but I just became fed up with it and I said, "This is not good for me." And I did a lot, made a lot of other mistakes. Not that it was a mistake, but I would've – it needs to be more comprehensive. I think some good sprinting workouts would've been better along with some resistance training. But I'm glad I didn't go into resistance training when I was early, because I probably would've overdone it, been overzealous and gotten way too big. And that's not good either. So, you got to get this fine balance. It's like the Goldilocks dose.

Dr. Tim Noakes:

Yeah. Yeah.

Dr. Joseph Mercola:

But what is your view on the cortisol? Because you're just such a magnificent scientist, and I'm sure you've read the literature and you've got a perspective that's valuable and can help us understand your perspective.

Dr. Tim Noakes:

Yeah, well, I've seen patients with hypercortisolism and they get old very quickly. So, I'm sure it has to have a role. So yes, I would agree with you. And how do you bring it down? That would be the question. I think it's the whole life experience, as you sleep, the stresses and so on. So, we've started – I started as an athlete, running, that was going to save the world, then I realized it's not. Then we moved on to diet and we realized that that's not the whole solution as you've indicated, or you have to refine the diet and you've got to take supplements and now sleep, et cetera, and lack of stress. The human is a complex animal and we are all biologically slightly different. And I agree with you that it's a personal experiment. I think what worries me – if you look at the global picture and the reason why you've been criticized – is, I agree with you, health is your responsibility or it's my responsibility. It's not the state's responsibility.

And that's what's happened. The state is trying to take responsibility for our health and invading our freedoms to do what we can do. And they're making people a lot less healthy because they're actually not interested in making us healthy. They want to make us part of this Big Food, Big Farmer, captured. So, we're captured by them and we become sick. And the only way we can get out of that is by taking responsibility for your own health, as you have done and as I've done. And that's what we promote.

Dr. Joseph Mercola:

Well, thank you for that. And I want to respond to your – I'm excited and delighted actually, that you can shift it over to resistance training. I'm assuming you're still doing some cardio or [did you] just stop that completely?

Dr. Tim Noakes:

Yeah, I run twice a week. Yeah.

Dr. Joseph Mercola:

Okay. All right. So, you may not know of my work, but I've been a big promoter of a form of resistance training that incorporates blood flow restriction (BFR) therapy, which are essentially somewhat like blood pressure cuffs, but except they're much thinner and they're applied to your proximal extremities, your arms and your legs, not at the same time. And they, cyclically, are pumped up with pressure to stop venous flow return to the heart, yet still allow arterial flow into the muscles. So, it's generically called blood flow restriction therapy, but it was actually developed by a Japanese scientist over 50 years ago, actually a little bit after we both started running. So, that's a long time ago. But anyway, his implementation is called KAATSU. It doesn't make any sense from an English perspective because it's a Japanese word and it means additional pressure. And the reason I mention it is I think you might find it profoundly beneficial. It's particularly useful for people over 50 and 60 because you can get the same resistance training benefits with 70% to 80% less weight.

So, it virtually eliminates the risk of injury. And I'm sure you're aware that is one of the primary reasons why people have to stop training — because they get injured, they wreck up their tendons and ligaments, and it definitely limits them. So, it's magnificent and I've been using it for about six years now. And I think some of the hacks I've done for my diet, essentially, it increases the type 2 muscle fibers in the cell big time because as you get older, the ability, the vasculature – There are exceptions. If you're a competitive endurance athlete, you might have really good blood supply, but most people's vascular supply to the stem cells, the type 2 fiber stem cells, gets limited, the microcirculation to the type 2 satellite stem cells.

So, if you've got this going on, it actually increases VEGF (vascular endothelial growth factor) locally in the tissue, and it activates those stem cells quite amazingly so that you get these fast-twitch fibers that are trained really well. And as a testimony to this, I was at a Biohacking Conference two months ago now, and a friend of mine was big into arm wrestling and he was 4th place in the world championships once, and he had a table there and he was teaching people how to do it. So, there was a younger anti-aging doctor there too, he's 30 years younger than me and pretty muscular. Actually had probably more muscle mass than I did. And we arm-wrestled and I

wound up beating him. And I'm not saying that to brag, just as a testimony [to] the fact that this type of training is amazingly effective. And if you're interested, I'll send you a video that discusses it more. And again, I can send you one of the KAATSUs to use in your workout, because I'd like to gift you that for all the amazing work you've done for humanity.

Dr. Tim Noakes:

Well, I would love to do that because I'll take it to my coach and we'll experiment with it.

Dr. Joseph Mercola:

Yeah, I think it's really amazing stuff. And you can radically – the key thing is you're going to prevent injuries, which is what stops most people. And in fact, the typical 74-year-old who hasn't been engaged in exercise like you have their whole life, they wouldn't even need to use weights with this. They would just do a bicep curl with just the band on. That's all the resistance they would need. And most other people that age are going to use 2, 3, 4 or 5 pounds. It's unusual [if] you're going to use more than 5 pounds.

Dr. Tim Noakes:

That'll be really interesting. I'd love to see that.

Dr. Joseph Mercola:

Yeah, and you'll see it. You'll feel the burn and things and it's really, really good. So, I'm glad you're open to that. I'll send you the information and then if you want to do it, just let me know the address to get the item sent to.

Dr. Tim Noakes:

Excellent. So, send me an email and I'll respond.

Dr. Joseph Mercola:

Okay. Good. Good. All right. I think that covers most of the things I wanted to discuss with respect to – I thought it might be a little more fiery exchange, but I don't think that's in your bloodstream because you're so kind and respectful and gentle.

Dr. Tim Noakes:

Well, yeah. So, what is truth? I've been wrong so many times, but fortunately been right many times too, as you've experienced. So, you learn that what is truth? Well, truth is what hasn't been disproven and [inaudible 01:02:53]-

Dr. Joseph Mercola:

Yeah, that's the model of science.

Dr. Tim Noakes:

-not settled.

Dr. Joseph Mercola:

Yeah, that's your hypothesis. You're always trying to disprove it.

Dr. Tim Noakes:

Yeah-

Dr. Joseph Mercola:

Which, it has morphed away. That's not the type of science that's mostly being done today.

Dr. Tim Noakes:

Yeah. But again, you've had a life experience and if you find something works for you, I believe that, I trust your judgment. How can I say you're absolutely wrong until I've seen other evidence? And that's how we should be, and we are not like that. We tend to "Oh, but you can't be right because the low-carb group believes this and you believe that." No, no, no, no. None of us are absolutely true, absolutely certain of anything.

Dr. Joseph Mercola:

Yeah. Spoken like a true, authentic scientist that you are.

Dr. Tim Noakes:

Thank you.

Dr. Joseph Mercola:

And just to give you some confirmation, because I didn't tell you my biological parameters, but when I shifted over from high-fat, low-carb to relatively high-carb, low-fat, my carbs went from 150 grams a day to 400 or 500 grams. I dropped 10 pounds. My body fat decreased 3%. My fasting blood sugar went down 10 points. So, my body was telling me, "This is something your body wants to do." It was clear from blood work perspective and biological parameters, I was moving in the right direction. So that's what intrigued me because I like to test these theories out of myself personally before I start embracing, espousing them to others.

Dr. Tim Noakes:

Well, I must tell you, one of the first ladies who we converted had told me all of these stories and has had me reading the material on the high-carb diet for treatment of diabetes, so I'm not unaware of the-

Dr. Joseph Mercola:

Okay, good. Yeah. The things I would just be careful of though is the linoleic acid, and when I send you information about the KAATSU, I'll send you an article I wrote and a really good comprehensive video that details it and it's specifically how you lower the linoleic acid. But unless you're lowering linoleic acid, high-carb is going to be not a good strategy. And you still have to integrate it. If the person doesn't have a lot of exercise output, if they're not generating a lot of calories, then they can't go too much above their base metabolic rate. You can't give them 400 or 500 grams of carbs. It will be a disaster, an absolute disaster. It has to be appropriate to their physiology, and [for] many people, it's going to be 200 [or] 300 grams at most, and even then, it's going to be a problem for some. So, you can't cure diabetes with that universally unless you individualize and customize it for that person.

Dr. Tim Noakes:

Yeah, absolutely.

Dr. Joseph Mercola:

All right. Well, I didn't realize we'd be in such a line [of] disagreement, but I'm not surprised. You've got such a magnificent life, work and history, and I'm just honored to be able to dialogue with you. So, thanks for all your work.

Dr. Tim Noakes:

It's been my honor. Thank you so much. A great privilege to speak with you. Thank you. Thank you, Dr. Mercola.