

Cancer and Ketogenic Diet:

A Special Interview with Dr. Thomas Seyfried

By Dr. Joseph Mercola

JM: Dr. Joseph Mercola

TS: Dr. Thomas Seyfried

JM: 1,600 people will die today, in the United States alone, from cancer. We have an epidemic and emergency in this field. There are 21,000 people in the world who die every day from cancer. Tragedy, for sure. The good side is there is a treatment protocol that can radically address, prevent, and treat most of these.

Hi, this is Dr. Mercola, helping you take control of your health. Today I am joined by Professor Thomas Seyfried from Boston College, who is one of the current pioneers in the application of this therapy, which stems from Dr. Otto Warburg.

Most of you watching this have heard of Warburg before. He was, as most experts would not argue with, recognized as one of the most brilliant biochemists of the 20th century. Most people know he won the Nobel Prize in 1931 for the discovery of metabolism of malignant cells, but what they don't know is that he also was an MD and a PhD, and was personal friends with Albert Einstein and many of the luminary brilliant scientists of his time.

He also did not just get one Nobel Prize, he got several. The problem is he was a German and chose to stay in Germany. Hitler did not allow him to collect his second Nobel Prize in 1941. He was nominated for a third. Brilliant guy. He came up with this theory. He's passed away, I believe, in the late '70s, maybe early '70s.

He's had some disciples instead. His first disciple who took up his... Warburg's burning passion was to find a cure for cancer, and he did. He really did. But because he was really eccentric and lived in Germany, no one, no one except for his physicians, except for Dr. Peter Pedersen at Johns Hopkins University, who took up the cause I think in the early '80s and did a lot of novel work with Dr. Seyfried, will discuss.

Dr. Seyfried was next. I believe Dr. Seyfried is a third-generation Warburg disciple who's really doing some incredible research to advance this science. He started it in the late '90s or 2000s. He's had some novel contributions that we'll discuss about. But I think it's just really profoundly illuminatory for helping you understand what the true cause of cancer is. He far exceeded Warburg's initial supposition. With that preface, I would like to welcome you and thank you for joining us today, because we're really anticipating and eager to engage in this discussion.

TS: Thank you very much.

JM: Can you hear me okay?

TS: I can hear you just fine, yes. Thank you very much for having me on and telling you a little bit about the stuff that we've been doing.

JM: Yeah. Well, you're going to expand on that because you are clearly the expert. But I think maybe we can expand on Warburg's work and how you got... I think you got into this because you were studying seizure disorders as many people do, which is the undisputed and uncontroversial application of nutritional ketosis as the treatment choice for intractable seizures. Why don't you tell us that story and share what your current position is at Boston College?

TS: Right now I'm a professor of Biology. Our mission here is to read the research and teach. We have a cancer metabolism class that I teach. I also teach general biology to the non-majors, because some of these students, it will be the only opportunity they have to hear about some of these things. We educate them about a lot of issues on energy metabolism, cancer, and general and biological issues that are going to help them better negotiate through their lives in understanding certain concepts.

We have an active research program that evaluates not only cancer but also some neurodegenerative diseases like Takayasu's disease. Also, we're using ketogenic diets to help deliver drugs to the brains of individuals with neurodegenerative diseases. Some major focus, of course, is the use of metabolic therapies for managing cancer. This has been a major input and activity of ours, and it continues.

JM: Okay, great. The traditionally held view is that cancer is a genetic disease. But what Warburg came up with, which you don't believe, and I certainly don't believe, is the significant amount of emerging evidence that shows that cancer is really a defect in the cellular energy metabolism of the cell, primarily related to the function of the mitochondria, which really wasn't known too well in Warburg's time. Not only... We think it was officially recognized and assessed... I think it had a name but they didn't discover the full characteristics of mitochondria until after Warburg, after he won the Nobel Prize, but certainly while he was alive.

Why don't you expand on that? Because I think that's essential and important to do. I've interviewed you before, and I've recently read Travis Christofferson's book, *Tripping Over the Truth: The Metabolic Theory of Cancer*, which you're prominently featured in. For some reason, everything clicked together. I've just been beyond passionate about this topic ever since. It's really the full focus of all my time and energy, to expand on this, and consolidate the information and present it in a digestible form that people can understand.

This is the game changer that not only treats cancer, but almost every single disease known to man, because at the foundational core is mitochondrial dysfunction. Why don't you... I love your work because you're such an eloquent explainer of this topic. I'll turn over the mic here.

TS: You've certainly touched upon a lot of very important points in our understanding of what the nature of cancer is. The first point, of course is... You're right. Cancer is generally considered a genetic disease, and I refer to this as the "dogma of the field." A dogma is an interesting concept. A dogma is considered irrefutable truth, and that cancer is a genetic disease is, no question, it's a dogma. The problem with dogma sometimes is it blinds you to alternative views and sets up ideologies, which are extremely difficult to change.

The idea, of course, as I say, when we look at cancer... If you go to any of the genetic textbooks, Biochemistry, Cell Biology, and whatever, all of the major college textbooks talk about cancer as a genetic disease. The National Cancer Institute (NCI) website, the first thing they say is cancer is a genetic disease caused by mutations. The question is, when you have it coming from the highest levels of the established scientific knowledge base, obviously, how can all these people be involved? How can all this be misunderstood? If cancer is a genetic disease, everything flows from that concept. It permeates the

pharmaceutical industry, academic industry, and textbook industry. The entire knowledge base. There's very little discussion of alternative views to the genetic view.

The argument now is that yes, metabolic problems occur in cancer cells. No one denies that. But these are all due to the genetic mutations. Therefore we must maintain ourselves on the established track that all of this metabolic stuff could be resolved if we just understood more about the genetic underpinning of the disease.

Now that would be well and good if it were true. But evidence is accumulating that the mutations that we see that are the prime focus and the basis for the genetic theory are actually epiphenomenal. They're downstream effects of this disturbance in the metabolism that Warburg originally defined back in the 1920's and '30s.

Now this is a very hard pill to swallow. If you have focused your entire career and enormous industries, multiple overlapping industries for therapies and whatever, on the idea that we need to understand the genes, we need to have precision medicine that's going to target these anomalies, and then someone comes along and says that those anomalies are really epiphenomenal, they're not the prime issue that you should be dealing with, this is a very difficult concept to accept or understand.

It's not so hard to understand it. It's harder to accept it. This is the issue. It's not like people don't understand what we're saying. It's just that they refuse to accept that this could be the truth behind the nature of the disease.

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And this then comes into the idea that okay, if cancer is a metabolic disease, and the mitochondria are responsible for the origin of the disease, and the defective mitochondria are responsible – the defective energy metabolism is responsible – for the majority of the phenotypes you see, then how do you deal with the disease knowing that? So you say... Most of the energy in our body comes from respiration, we breathe air...

JM: Excuse me for interrupting, but I want to take a little tangent to reinforce the concept you just stated, that cancer isn't a metabolic disease despite what almost every single expert says otherwise. I want to refer to the brilliant work, I believe one of your most magnificent contributions to this science, where you compiled research from some brilliant scientists, who were all independent well-respected scientists within their disciplines, who conducted experiments but had no clue how to interpret them. But you did. You put it all together.

You know what I'm talking about, with the transportation proponent. I think that will absolutely reinforce these concepts. We need to establish in people's minds that yes indeed, cancer is not a genetic disease.

TS: Those experiments that you mentioned were always present in the literature, the nuclear transfer experiments. They were considered basically anomalies. They were not consistent with the view that cancer is a nuclear genetic disease. They were more or less looked at but not viewed in light of the origin of the disease. You come across these occasionally, spread out over several decades, in frogs, mice, certain humans, and these kinds of things. They all came to the same basic observation, but the observation was not interpreted in light of the origin of cancer.

What I simply did is I bundled all those observations together in a new light, looking at the conclusions of those experiments, in light of whether the results would support a nuclear gene-based theory versus a mitochondrial metabolic theory. I think that's the contribution. It was just interpreting a series of experiments in light of the origin of the disease, and then asking what conclusion would these

experiments support. Would it support the nuclear genetic theory of cancer, or would it support the mitochondrial metabolic theory of cancer?

In each of these cases, the results more strongly supported the metabolic theory of cancer than the nuclear genetic theory. Basically, these experiments, what was interesting... So let me just say, you take the nucleus out of the...

What we're doing is we're looking at this in the sense of the nuclear transfer experiments. The nuclei of tumor cells were transplanted from the tumor into a new cytoplasm, a new cytoplasm that would contain normal components of that cytoplasm, which include the mitochondria, the energy-generating organelle of the cell.

The hypothesis, of course, is if cancer is nuclear-gene driven, and the phenotype of cancer is dysregulated cell growth, if the mutations are responsible for the phenotype of the disease, then those genes should be expressed in the new cytoplasm, producing a phenotype consistent with the mutations in those oncogenes or tumor suppressor genes responsible ultimately for dysregulated growth.

What was observed in repeated cases, over and over again, is that these new cells containing the tumor nucleus with new cytoplasm did not form cancer. They did not grow unregulated. They became part of this society of cells as the organism developed. What was interesting is that in many of these nuclear transfer experiments, the organisms aborted at certain periods of development. That abortion seems to be related to how many mutations were in the nucleus that was transferred.

It was true that these cancer nuclei did contain mutations, but those mutations were not causing the hallmark feature of the disease, that is proliferation. Rather, they were causing abortion at some developmental point of the organism that had those nuclei. The mutations, of course, you can't complete normal development if you have broken chromosomes, point mutations, deletions, and all the kind of genetic defects that we see in cancer cells. But the core, the key phenotype of abnormal proliferation was not seen in any of those experiments.

On the other hand, when the normal nucleus was transferred back into a cancer cytoplasm, either the cell died or it formed tumor cells.

JM: And that cancer cytoplasm had defective mitochondria.

TS: Yes. That's right. Further evidence came even more recently from Benny Kaiparettu and his colleagues at Baylor University with a transplanted mitochondria, just a mitochondria leaving the nuclei there. The transplantation of normal mitochondria into a cancer cell cytoplasm caused the cells to stop growing abnormally, downregulated the oncogenes that were supposed to be driving the tumor, and made these cells grow normally. Then if you took the mitochondria out the tumor cell and move it into a very slow-growing type of cancer cell, these cells now grew like crazy.

It was clear, when you bundle all these experiments together, you come to the conclusion that the nuclear mutations cannot be the drivers of the disease.

JM: If you're a rational human being.

TS: Well, I wrote it in such a way comparing contrast the two observations in light of the two competing major theories of cancer: the mitochondrial metabolic theory versus the nuclear gene theory. It should be obvious to most rational thinkers that these observations are the strongest data to date that say that cancer cannot be a nuclear driven disease. Now the argument, of course, is that when we have all these rare inherited forms of cancer, like Li-Fraumeni syndrome and BRCA1, these kinds of diseases. Therefore

people say, “Well there’s clear evidence that cancer must be a genetic disease because people inherit genes that cause cancer.”

The answer is, yes, on the surface, that would appear to be true. But those genes and coat proteins of the mitochondria, and the mitochondria, become defective as a result of those inherited mutations. As Warburg said, there are many secondary causes of cancer, but there is only one primary cause, and that’s damage to the respiration. So inherited mutations through the germ lines that cause cancer to affect the mitochondria, it is the mitochondria that is the origin of cancer. It just so happens that that defect is coming from an inherited gene rather than a chemical carcinogen, radiation, viral infection, or an infection of some parasite or whatever. All of which damage respiration, all of which can cause cancer.

Clearly the origin of the disease is a disturbance of the respiratory capacity of that cell, which then if the cell is to survive, it must upregulate genes necessary for fermentation. Many of those genes are the so-called oncogenes. The oncogenes are simply fulfilling a rescue event of that cell to function in a fermentation metabolism rather than an oxidative metabolism. We can downregulate oncogenes simply by putting in new respiration. This is the origin of it.

JM: Thank you for that very eloquent and detailed description. It’s just a load of information, and I’d just like to extract one kernel and highlight it, because sometimes if you separate it with silence, people understand, rather than compact it with other facts. The item I want to highlight is Dr. Warburg said that there are many secondary causes of disease, but there is only one primary cause of diseases: defective mitochondrial respiration.

TS: That’s right.

JM: That’s the key. You’ve got to understand it. You have to understand it. The traditional scientific community is not going to agree with you, but if you just listen again, because there’s a lot that you’ve put out that gives a lot of information. Maybe you can replay it as many times as you need to understand it. But that is the most rational and irrefutable evidence that any single person can understand. I’ve never seen a set of compiled experimental data that proved it more eloquently than you did. Thank you so much for compiling that. That’s a major service to humanity.

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TS: And the idea, though... In light of that, you have to explain how the mutations occur. You see, this also has to be explained and how the mutations are not the primary cause but the secondary cause. The answer to that is once the respiration becomes damaged, if it’s damaged too acutely, all of the cells die. So it can never become a cancer cell from a dead cell. The respiration in the cell is chronically damaged. The chronic damage then leads to a compensatory fermentation. As I said, it requires an upregulation of oncogenes.

But the damage to the respiration also produces reactive oxygen species (ROS). These are radicals that damage DNA protein and lipids. Those ROS, if...

JM: Lipids are inside your membranes, which compose large portions of our biology. If our cell membranes aren’t functioning well, then we have serious problems.

TS: Yes. What happens now is these reactive oxygen species, they not only damage further the respiration, but they also cause mutations in the nuclear genome. Here come the mutations, the mutations come as the result of the defective respiration producing reactive oxygen species. This is the mechanism showing how the mutations, the hundreds of thousands of mutations that we see, are coming as the result of the reactive oxygen species generated from faulty respiration.

The field is focusing on the downstream effects of the problem. Okay? Personalized medicines, checkpoint inhibitors, all of these kinds of therapies are basically looking at downstream effects of the disease. Yes, in of a certain population of cells have that particular defect, you can target that defect, you may in fact have success in some individuals that may have a considerable number of their tumor cells having that checkpoint defect.

JM: Absolutely.

TS: Unfortunately, most of the cells in the tumor are all different from each other genetically. You're not going to be able to target all of the different cells using these kinds of approaches. Even though you may get success for a few months, or even a year, in some people, majority of people will not respond effectively to these kinds of therapies for the most part.

JM: Okay. Thanks. I wanted to focus on one of the components you said, because you mentioned this element of reactive oxygen species and the generation of secondary free radicals. One of the targets that you left out of your list is the actual mitochondria themselves, where respiration occurs.

TS: Yes.

JM: Let me just forward the questions, because it's really an important one. I'll let you expand on it. I believe that a lot of part of the reason why mitochondria become dysfunctional is because we're eating dirty fuel. What do I mean by that? Glucose burns dirty. That is what almost everyone is burning as their primary fuel, Fat, more specifically ketones, burn much, much cleaner. They generate far less reactive oxygen species. If you have less reactive oxygen species being generated in the mitochondria, less mitochondrial damage, less signaling defects occur transmitting to the nuclear DNA, and less damage.

Not only is refining the fuel that you're feeding your body the key component of treatment of cancer, but in my view, it is the primary way that you prevent cancer. So I'll let you...

TS: I think that's an important point. One of the things that trigger cancer is inflammation. We have inflammation. Chronic high levels of blood sugar create inflammation. This you see in a lot of situations. Glucose itself is not carcinogenic. But elevated dysregulated glucose metabolism can lead to inflammation, and can lead to... It can cause a number of other disturbances in the overall metabolism of the body.

If you fast, if you stop eating, your blood sugar goes down. Your insulin levels go down. The body starts to metabolize fat for energy. But the fatty acids themselves are only one component. The major components of course are the ketone bodies. It's like putting a board or a long branch into a wood chipper. The fatty acid is the branch that goes into the chipper and out come these little ketone bodies. They are water-soluble fat products. They readily enter cells and they're metabolized to acetyl-CoA through a series of steps.

These steps generate nicotinamide adenine dinucleotide (NADH), which is a reducing equivalent. But they also keep the coenzyme Q couple in an oxidized state. This is very important because it's that coenzyme Q couple where reactive oxygen species are in fact generated in the first place. This is a little bit heavy on the biochemistry.

Richard Veech of the National Institutes of Health (NIH) has done the majority of work on that pathway. He was Hans Krebs' last student, by the way. He has elegantly demonstrated how the ketone bodies...

JM: Let me just interrupt there. Krebs, I forgot to mention in the introduction, was actually a student of Warburg and actually wrote Warburg's biography.

TS: That's right. The biography was edited by Richard Veech at the NIH, who was Krebs' last student. Krebs also had a great interest in ketones. He did some incredibly important work on the way the body uses ketones. Ketones are clean fuel only in the sense that they suppress the formation of reactive oxygen species, especially when blood sugar levels are low. Okay? Because if you have very high ketones and high blood sugar, you have ketoacidosis, which is a life-threatening event.

JM: Especially in a person with insulin insufficiency in type 1 diabetes. Not in nutritional ketosis.

TS: No, not in nutritional ketosis. Very rare can a normal person with normal physiology get ketones above 7 or 8 millimole (mmol). If you have ketoacidosis, it's 20 mmol. It's so far from that range. Therapeutic ketosis is a healthy lifestyle, healthy for maintaining maximum energy efficiency and reducing reactive oxygen radical production. Mitochondria actually get very healthy when ketones are metabolized as opposed to some of the other fuels, like glucose. Especially glucose.

JM: This is a point I'd like to emphasize from a different perspective. Because, traditionally, for the last few decades, most natural health enthusiasts were understanding the reactive oxygen dilemma, and their attempt to circumvent this challenge would be to swallow antioxidants either through foods high in polyphenols or other natural antioxidants, or supplements in attempt to reduce them. But I think that's a flawed strategy. It's a fatally flawed strategy, because it's far more effective to address it at the source, which is changing the fuel.

It's not that ketones don't generate any reactive oxygen species, because another piece of information that many people fail to appreciate, I think many health professionals, is that reactive oxygen species are also signaling molecules, very powerful signaling molecules. If you suppress them indiscriminately, you are going to have biological dysfunction. You do not want to eliminate them. You just want to control them to optimal levels so all the signaling occurs ideally. That's what happens with ketones. You're pretty much in an ideal therapeutic window.

TS: Yes. You're right. There's no question about that. It's what we call a homeostatic state. Ketones, they prevent a dysregulated reactive oxygen production. That's basically what it is. Aging essentially is... We age because we collect oxygen radicals in all the tissues of our body. Age is basically the second law of thermodynamics, which is entropy. Disorder. We spend our whole life pushing the boulder up the hill. But eventually the boulder does win, because none of us survive... You have to be immortal.

JM: I think there's another variable there, with respect to aging, some important consideration, is that... It's not so much as pushing the boulder up the hill but ultimately it's a failure of the repair mechanisms that are there. Once you damage those repair mechanisms, specifically mitochondria – mitochondria biogenesis – once that is damaged, then you're going to need a clutch.

TS: Yeah. The boulder rolls downhill faster.

JM: Absolutely.

TS: But basically that's all we're doing. Calorie-restricted ketogenic diets, ketone metabolism, and these kinds of things delay entropy.

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TS: Particularly what you're doing is delaying the second law. You're allowing your body to remain healthier for a longer period of time. That's basically what we're doing here.

Cancer is accelerated entropy. It's a total disorganization of the homeostatic parameters within cells and outside the cells in the morphogenetic field and in the entire body itself. Cancer patients have all kinds of disturbances in systemic homeostasis. It's not just in the cells.

You see, the problem is many people focus on cancer as a reductionist cell. It's only in that cell. When the body has cancer, there are a number of ramifications that take place throughout the body. We're producing more acidity within ourselves. There are a lot of responses in the part of hormones and signaling cascades throughout the body as a result of this disease. One has to treat cancer as a systemic [disease]. The whole body has to be treated but in a non-toxic way.

This is the failure of the current treatments. The majority of treatments for cancer are extremely toxic to the body causing even greater disturbances in the homeostatic state of the body. When you look at cancer as a metabolic disease, there are ways to target and manage the disease without creating systemic toxicity. Most of the standards of care for cancer are extremely toxic.

When you view the disease as a metabolic disease, you just have to simply target the fuels that the cells are using. That's primarily glucose and glutamine. If you can switch the body away from these fuels, you have a better chance of providing longer-term management without toxicity. It's a little bit more difficult than what I said here, but that's an interesting strategy.

JM: Right, and I want to discuss those now. But before I do, I want to emphasize another important point to kind of frame the discussion around. We focused on the discussion of cancer. I want to ask you one question before we go into the details.

But the point I want to make is that it's not just cancer. Yes, 1,600 people will die today, and I believe... I'm just going to ask you the question now because you probably have more experience using this nutritional ketosis as a clinical intervention or treatment intervention for cancer than anyone I know of. I'm wondering what your guess would be on how... Of those 1,600 people that will die today, what percent would this intervention eliminate the cancer?

TS: This is a very difficult question. We can't say if the metabolic therapy will eliminate the cancer. In other words, the so-called cure. The cure is... I don't know. It's an arrogant kind of thing. We're going to cure cancer, right?

JM: Warburg wanted to do this. Pedersen wanted it, too.

TS: Yeah. But I don't say it. What I'd like to say is can we effectively manage the disease, so that people can get on with their lives and not be crippled by the problem? I look for long-term management with a good quality of life. Now, we don't know who's cured from cancer. The issue is if you die from old age... If you had cancer, let's say, at 40, and you die at 93 from something other than cancer, we would know you were cured from your cancer.

JM: Right.

TS: But we can't know that because many cancers come as a result of the treatments. They use this five-year thing. If you don't have cancer, you can come back in five years and they'd call you cured. But 15 years later, you get a new kind of cancer that came as a result of the treatment from the first cancer. That could be from toxic chemicals or radiation or a variety of other things that would be used. Was that person really cured of that cancer? Was it the same cancer or a new cancer that came back? It's very hard to say that.

What I like to say is can we manage cancer and maintain a high quality of life for as long as we possibly can? I think that's a more rational view to this rather than saying ketogenic diets are going to cure cancer. I never said that.

Other people say ketogenic diets will cure cancer. Now, if someone's on a ketogenic diet for seven years and their cancer is still there but is not progressing, are they cured or they'd managed? These are the kinds of concepts. I don't like to say that we can cure cancer; I like to say that we can manage cancer and keep people in a state of quality of life.

JM: OK. That's a fair and really good response to my poorly worded question. Let me reframe the question. What I really meant to say... Because my focus is really on prevention. Rather than go and try to plug the holes in the dike, let's go upstream and figure out where the problem is flooding, so we don't have any holes at all.

If we would use nutritional ketosis (which I prefer than ketogenic diet, because of all the bad image of the term ketones), effective nutritional ketosis as a therapeutic intervention prior to the diagnosis of cancer, what percentage of those who would develop a cancer do you think it would be effective? I think it's over 90 percent. I'm wondering what yours is.

TS: I would say just the same thing. It's between 80 and 90 percent. And who's to know? Because we haven't really done any of those experiments. These are purely speculative statements.

But what we have to recognize, in light of what we've done and others, is that if cancer is a mitochondrial metabolic disease and you get cancer because of mitochondrial failure in certain populations of cells and certain tissues, if you prevent your mitochondria from entering into this dysfunctional state and cancer is a mitochondrial metabolic disease, the probability of getting cancer is going to be significantly reduced. To what percent? I would say probably 80 percent, a minimum of 80 percent.

Cancer is probably, as I said in my book, one of the most manageable diseases that we know of. Very little energy is given into prevention. Most of the energy in cancer is for cures – finding cures, finding new treatments. The federal government spends very little energy on prevention.

Now, the problem, of course, is that many people (I don't want to say all people) don't want... They're like, "What do you have to do to prevent cancer? I'm going to have to therapeutically fast for a week? Oh, I'm not going to. Give me a break. I'll roll the dice and say, 'Let me see if I'm going to get cancer.'" It's like, "I have to exercise?" An effective prevention is to eat less and move more. A lot of people they don't want to do that.

But I have to admit, the younger people are recognizing this. I think that more and more people are becoming... Once you realize what cancer is, that it's a metabolic disease, you can take charge of those kinds of things. In other words, getting cancer is not God's will. It's not the fact that you have bad luck, as some of the scientists say, "You have nothing to do. You just have bad luck. It's in your genes. You've got bad luck." This is not accurate.

You're exposed to our environment. I agree with you. Our food industry is producing massive amounts of food that's nutritionally deficient and full of things that can cause systemic inflammation contributing to the risk of cancer. We're bombarded. The food tastes so good. They tweak our love of glucose, our love of sweets. It makes us...

JM: Another thing you're probably not aware of: we spray, I think, almost a billion pound of glyphosate as Roundup on our food crops that are mostly fed to animals. It's a potent, potent contributor to mitochondrial dysfunction. I just learned that last week.

TS: Yeah. I'm saying there are so many things in our environment that contribute to mitochondrial dysfunction. That manifests itself not only in the form of cancer; it manifests in the form of type 2 diabetes, cardiovascular disease, or Alzheimer's disease.

Alzheimer's disease is another one of these metabolic problems. People who have Alzheimer's disease are hypometabolic. One of the questions at the National Cancer Institute (NCI) was how come people with Alzheimer's disease have a lower risk to get cancer? That was one of the provocative questions. The issue is that they have low blood sugar levels. They are hypometabolic. It's very hard to drive a tumor if the fuels that drive the tumor are in low concentrations. The bigger question is why people with Alzheimer's are hypometabolic. What's going on with their metabolism that puts them at risk for that disease?

Rather than focusing on the genetic variants... Yeah, like all diseases, we have some that are inherited. These are rare genetic variants in the population. But the majority of these different chronic diseases are the result of our environment, a gene environmental interaction. The question is, OK. There's nothing I can do about my genetics. I've inherited this. I can't go about and retool my genetics. But I certainly can recognize the environmental factors that could predispose me for these kinds of diseases.

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What can I do to reduce the impact of these negative environmental factors? One of these is to keep your mitochondria healthy. How do you do that? You burn ketones, all right? People will go out and have ketone drinks. They go out and have a big ice cream sundae and then swallow a bunch of ketones. That's not going to help. You know what I'm saying, right? People do these things.

JM: Actually, I was going to ask you about your viewpoint, not that strategy but in addition to, the difference of using therapeutic and exogenous ketones or short-chain fatty acids like lipoic acids and medium-chain triglycerides. But we'll discuss that in a moment.

TS: I'm just saying that your body retains ketones when blood sugar is especially lower, otherwise you pee out the ketones. This is another thing. Because we've done the studies in mice and we've seen this.

JM: You can't have ice cream and ketones, too.

TS: No. You can look at it that way, too.

JM: I just want to expand a little bit. First of all, thank you for that response. I wanted to frame that around there. Describe in a little bit more detail what motivated you to be passionate about this. I have a strong view on vaccines largely because I know the damage they do, and I know that I did it to thousands of people. I treated thousands of kids. I ignorantly contributed to it. I'm really motivated about that.

Similarly, I'm motivated about this cancer even though I didn't contribute to it. It just somehow motivates me emotionally the same way. The best film I've ever seen to illustrate this (it's a bestselling book too) is *The Fault in Our Stars*. I don't know if you've seen it. *The Fault in Our Stars*.

TS: I've heard of it but I haven't seen it.

JM: I would strongly recommend it. But I would caution you to only view that movie with a full box of Kleenex.

TS: OK. I'll write it down.

JM: That contributed. Reading Travis' book and watching that film. It's this confluence that motivated me. But then I started to suddenly realize that, as you mentioned, it's not just cancer. It's

neurodegenerative disease, Alzheimer's, Parkinson's, and amyotrophic lateral sclerosis (ALS). Then you've got diabetes, obesity, seizure disorder, for sure. It's slam dunk. Hypertension. Hypercholesterolemia. Everything that we're treating with all these drugs is basically solvable with proper nutritional intervention.

That's what I want to focus on the last part of this discussion, because the devil's in the details. How do we do that? I know this is where I think we're going to have some disagreements. I've come to a different conclusions from you have on how to achieve that state, because that's what we want.

You mentioned earlier that you have to reduce carbohydrate (and I'll let you respond to that) to certainly under 100 grams but probably under 50. By carbohydrate, I mean non-fiber carbohydrate. I eat 150 grams of carbohydrates – 100 grams of that is fiber; 50 grams is non-fiber carbs.

Then you said glutamine, but I think it's beyond glutamine. I connected you with Ron Rosedale to discuss this. But I think it's just total amino acid content. Certainly glutamine is important but there's a threshold of amino acid level that if you go above, you're going to stimulate the mTOR pathway, which in conjunction with insulin, may be a more powerful influencer on mitochondrial dysfunction and mitochondrial biogenesis than insulin. We'll talk about that. I'll let you respond to that and then we'll fine-tune it.

TS: The reason I mentioned glutamine is that the amide nitrogen of glutamine is the precursor for a synthesis of nucleotides DNA, RNA, and this kind of thing. The cells need to proliferate. Glutamine is one of the amino acids that...

JM: The most common amino acid in proteins.

TS: That's why I said the cells can use the glutamine. They can get energy from it and they can proliferate from it. Of course, glucose and glutamine is like a supercharged system.

JM: If you lower glutamine, you're going to lower protein. You just have to unless you're taking an amino acid supplement.

TS: You're absolutely right. And it's so much easier to target the glucose through these metabolic therapies than it is the glutamine. I think this is where the challenge is. But this is not an insurmountable challenge.

JM: No. It's actually not.

TS: It's just that we haven't focused on it as much as we focus on how many mutations a cancer cell has. If we would take all this knowledge base and figure out how to do this, we would be able to solve this problem in about five years. It wouldn't take that long. I hate to be flipping about this, but cancer is a very solvable problem.

JM: Relatively easily if people understand healthy clinical nutrition. Most clinicians don't. They're clueless.

TS: There's even a bigger issue. We can discuss the most adequate and best nutritional compositions of foods in reducing inflammation and this kind of thing. It's not going to happen because... I'm certainly happy for the people that understand and know about this. But for the majority of people...

We always have to look at economics. Money basically, whether it should become financially feasible to shift into this realm. There are two ways to deliver medical care in this country, (at least two, at least the two that I can think of):

1) Fee for service. Patient goes to the physician. He's offered this therapy, that therapy. This test, that test. Every one of these costs a certain amount of money that's added to the bill. The hospital balances their budget on this and everything.

2) The other is global budget where a certain amount of money is given to the hospital to care for the patients in that hospital. Now, if you do a really good job at caring for your patients, you can share the revenues from the money that was given.

JM: That's the biggest problem.

TS: Right. There's an incentive here. Now, if you can prevent chronic diseases like cancer, type 2 diabetes, or coronary artery disease through a dietary metabolic shift and train physicians and patients how to do this, you significantly reduce the number of tests and drugs you need to handle for those patients. Therefore, the caregivers themselves will financially benefit from this strategy versus fee for service in those two ways. This now becomes economically feasible to use metabolic therapies for treating these various chronic diseases.

This can happen in certain states and in certain situations. The question is what the incentive is, of course. It's that the physicians and caregivers are incentivized to use this kind of a therapy, because it's keeping their patients healthy out of the hospital and not having all these procedures that are needless and very costly. We can save the nation billions and billions of dollars using metabolic therapies.

JM: The healthcare budget is 3 trillion. We can save them trillions, trillions of dollars.

TS: We cannot continue to go down this path because it's going to cripple the entire country's ability to function in the world. We can't be spending 50 percent...

JM: The conflict of interest and the corruption between industry and basically a fascist governmental system. But there is a workaround. That's why I'm so excited, because there are people who understand the truth like you. There are large mouthpieces like myself who have reached to millions literally, tens and millions of individuals. You could offer them this program. It works. Their whole life changes. Their neighbors, their friends, and their relatives want to know, "What did you do?" And there starts to spread some ground level up. You change it from the bottom up. You don't change it from the top down.

TS: No. You're absolutely right. It can't be changed from the top down, because the interests in the top are not the same as the interests in the bottom.

JM: No. That will never happen. I'm catching about GMO labeling. Do you think we're going to try it with the federal government when Monsanto controls almost the entire federal government and the departments that are related to this? No, that's impossible. They've blocked it up. You got to do some ground level workaround.

TS: Yeah. I agree. I think that you're actually right. I think these kinds of approaches are not so terribly difficult or so mindboggling on shifting your blood sugar.

Now, we've published a paper on the glucose ketone index calculator (GKIC) in open access journal, which can be used for every person. Whether you're a healthy athlete, or whether you're a cancer patient or a diabetic patient, you can use the glucose ketone index calculator to assess the health vitality of your mitochondria. When you have a glucose ratio of 1.0 or below, you know your mitochondria are in a very healthy zone.

JM: That's a really hard index to go to. Just to expand, it's glucose to ketone ratio. Ketones by blood, not by urine, and glucose in millimoles, not in milligrams per deciliters. You can just inform them, sure. But

there's a chart that you can go online to see what your numbers are and convert them. I can't get to 1 below. I can easily get to 2, certainly between 2 and 3. I'm a 5 for sure. Under 1 is really, really hard unless you're totally fasting, which I don't think...

TS: You don't have to be in the 1 zone for very long. If you're a cancer patient, you try to hit that zone as much as possible. I'll talk about that because it's different for cancer patients and for healthy people. Healthy people can get down. One of my students got down to 0.3.

JM: Wow.

TS: And my colleague, Don D'Agostino, he was able to get down on that zone, too.

JM: Wow. But you can't stay there very long, because you have to be fasting for a number of days. Some type of water fast?

[----- 50:00 -----]

TS: You do a water fast for about 3 to 4 days, then you can take some ketones, and you can get your blood sugars way down.

JM: That's only short time. You cannot do that long-term.

TS: I know some cancer patients who are not taking any standard of care – no radiation, no chemotherapy – because all that stuff elevates. It's very hard to get a low index when your body is in a state of anxiety. There's a stress issue that prevents the index from going as low. It happens more in cancer patients than it does in people who don't have cancer. So, there's some anxiety. Cancer patients really have to work hard to get into that zone, into that ratio. But I've seen it happen so many times on healthy people.

But you're right about how long can you stay in the zone. To prevent cancer, you don't have to stay there, but for maybe 4 or 5 days every 6 months or something like this. It's just a guide. It helps individuals.

JM: That's one strategy. My viewpoint and philosophical impression is that it may be better to take an alternative approach rather than go to an extreme, which is really difficult. I mean, you have to be water fasting before your exogenous ketones get to those levels. Because normally, if the calorie restriction will work... But specifically if you can limit the carbohydrate, non-fiber carbohydrate, below 50 grams and your protein to below 1 gram per kilogram of lean body mass, which is pretty low. I'm 170 pounds now, a little bit less. That translates to about 70 grams of protein. Most people are taking a lot more than that.

TS: Sure. We also found that it's very individual. Some people can get into these zones very quickly and very easily. Other people really struggle. All of this is a biomarker gauge. We've done some very interesting linear regression analysis on survivality of mice with cancer using the GKIs, the independent variable, the glucose-ketone index. There definitely is statistical relationship on how long you can keep your GKI, how long you can survive with a very aggressive cancer. Clearly, it's just one biomarker system that allows individuals to help battle their own cancer.

As I said, if you combine that with certain drugs that work together with the system or certain nutrients that... Don't forget this is an emerging field. There's so much more we need to know to tweak this system, so that we can obtain maximal metabolic efficiency in our body while battling the disease.

These are biomarkers that allow the individual to assess where they are, where they need to go, or where they might think they need to go. Without that, a lot is speculation. We don't really know why this diet or that diet helped, or why this nutritional situation was more effective on one person than the other. We're

simply trying to get biomarkers to allow us to know how we can better assess why some people respond better than others. That's all it is. We try to link those together.

JM: Let's talk about that a little bit. What I neglected to mention earlier is that because I'm so passionate about this, I'm writing my next book, which is called *Why We Get Sick and How to Fix It: The Metabolic Treatment of Disease*. What I learned from putting this material together so far (it's just in the outline stage, but I hope we can have it out this year) is that you need a powerful online software, analytical tool to do a very detailed nutritional analysis of what you're eating. Otherwise, you're clueless. You can't monitor and change things. You don't know what you're dealing with.

Secondly, you need a fasting glucose. There's no way around it. You've got to know what your fasting blood sugar is. And probably even take it twice a day before you go to bed, so you know what your sugar is before you go to sleep and what it is when you wake up. You want to get to below 70. You want a fasting blood sugar around 60. That's where you want it.

TS: The thing too is that during the course of a day, you can fluctuate, as you know. The dawn effect. When you wake up in the morning, the blood sugar is much higher than what it is later in the afternoon.

JM: Without having to eat? I think I've figured it out – gluconeogenesis. You're not getting enough protein. Especially if you're water fasting, you have to have amino acids because your body metabolizes lean body muscle tissue, generates amino acids, and in process those excess ones get shuttled to the liver and generate the extra glucose. You could spike up your glucose to well above 100 even though you have maybe 10 grams of glucose or carbohydrates.

TS: You're right. See, this is one of the reasons we developed the GKI index. Because so many of the glucose, as you just mentioned, spikes. You can't believe it. This person got into an argument with the neighbor, the blood sugar went up to 160. They get all freaked out. They start to panic. If you divide it by the ketones, it becomes much less of a swing. The ketones more or less buffer these swings in glucose.

JM: You could change it by increasing... I would venture to say that almost all those cases are due to that person not having enough protein. They got to have protein, but you don't want too much.

TS: No.

JM: Go liberal. But they're probably getting 20 percent less than they need or maybe even less, 30 or 40 percent less.

TS: That certainly could be true. We don't know until we start doing these kinds of physiological measurements on larger numbers of people under different conditions. Using this index we will be able to precisely define...

JM: My personal experience though (because mine was 70 and I just experimented. I went down to 50 grams, especially with a little weight training) was that my blood sugar went up to like 120. The very next day, I increased my calories to 300 calories, 400 calories and increased my protein by 20 grams, 70 grams, or 65 grams.

TS: These are very important issues. I think a lot of us don't understand how our bodies work or our own physiology. What we're talking about here is a personal understanding of your body and how it responds to this. Most people don't even discuss this. They know very little about it.

JM: I couldn't agree more wholeheartedly with you. That includes many, if not most. My guess is that the vast majority of natural healthcare professionals who are advocating and embracing this concept, they don't understand the protein component. They haven't integrated that into the equation.

That is what the central crux and thesis of the book will be: to help people understand what actually goes into the biochemical pathways of mTOR and all the other pathways that contribute to it, so that they can understand the picture like you so eloquently did with your research, compiling it so brilliantly and providing the entire race with the most powerful illustration to refute the ignorance of the genetic theory of cancer.

TS: Yeah. This is the first step, the first step. The second step is the metabolic movement.

JM: Yeah. I can assure you I'm committed beyond 100 percent to making sure this thing happens. That is the highest priority in among everything I'm doing right now – to teach these principles – because it is core to everything.

It just bounces off brick walls of what almost everything's being taught, partially because of Atkins I think. Because he had an interesting idea, but he absolutely didn't understand this stuff. He was clueless about the dangers of excess protein or even the quality of food. All he thought was that low carb was useful. Yeah, that's useful sometimes, but a lot of times if you don't do it right, you're going to cause more damage than good.

TS: Yes. The other thing too is when you talk about ketogenic diets, they're not all the same. The ratios of the different fats to the proteins, to the carbohydrates are extremely important in how this actually works within your body. It's not just a generic fat.

JM: No. And it's probably individualized.

TS: Yes.

JM: You have to custom it yourself. That's why you've got to do testing. Yes, you can do ketone testing. There are three kinds of ketone testing: blood, urine, and breath. We don't recommend urine for reasons that we don't have the time to discuss now. You can do breath, which is pretty cool. But the blood is the best. It's a little bit expensive. You can get your sticks on eBay if you want. It's half the price. We don't test as much glucose. Glucose is 40 cents a strip, or 50 cents a strip.

TS: Yes. You're right. You're absolutely right.

JM: You clearly do not have to test that every day.

TS: Yeah. That's the whole thing. I think once people realize this, those ketone strips should eventually become the same price as the glucose strip.

JM: I hope so but I'm not too hopeful. And I'm not sure that it's necessary. My guess is (and you have to comment on this) that if you've been stabilizing it at 65 or lower on your glucose, you're going to have lower ketones. It's really hard to have low ketones with a low blood sugar.

TS: Well, actually...

JM: Or it isn't?

TS: They have low glucose levels but it's not clear that they have high ketone levels.

JM: But they'll have glucose for a metabolic reason not because of nutritional intervention.

TS: No. That's true.

[----- 1:00:00 -----]

JM: With nutritional intervention, you'll have low glucose. And the right amount of protein, the Goldilocks dose – not too much and not too little – you're in a therapeutic window. My guess is to actually have some short- or at least medium-chain triglycerides. I like MCT in coconut oil to sort of fuel the body because they can convert to ketones so much easier.

TS: Yes. You're absolutely right. As an individual it has to be managed that way. The awareness is very important in people.

DM: That's what I'm actually committed to do. You're a resource. You've really paved the way. I'm just really so appreciative for all the pioneering work you've done. You've been taking a lot of flak. You just painted a huge arrow or target on your back, and I'm sure you got a lot of arrows in there, because what you're promoting did not sync with whatever else they were teaching.

You and Pedersen were out there, and there were hardly anyone else. I mean, you've got Ko, one of Pedersen's grad students, but not many other people were doing this.

TS: In my lectures, I think the physician groups are the most responsive to this. Those individuals that must deal with patients on a day-to-day basis and knowing what they've been confronting for all these years, and then there's an alternative which makes a lot of sense to a lot of people, they wish they could do this more. The physicians in the trenches who deal with cancer patients are many of the ones that seem to be the most responsive.

The guys who get big grants from the NCI to study gene sequencing, these guys are less responsive to this as you could well imagine. But this will change. It has to change, because this is the path which will make the biggest difference to people's lives and eventually manage the disease. It's just how fast are we going to get to that. I think cancer can be managed fairly...

DM: That's a good question. You've been doing this for 15 years now, right? 15 years, or maybe 16, I don't know. You started in 1999.

TS: I've been doing biochemistry and cancer for a long time, lipids and things like this, but it was basic science. It wasn't linked or correlational.

DM: But for 16 years, what is your impression from your perspective on the shifts that have occurred over those 16 years? Give us your view.

TS: Now, for the first time we're initiating clinical trials on ketogenic diets. But it's like, we're stumbling. People say, "Oh, we need a big clinical trial to do this." Right now, because of the individual variations and so many loose ends that we're not really sure of, I'm not in favor of taking 100 or 200 people and putting them on a generic ketogenic diet to see what happens.

DM: No. Find the protocol first.

TS: We have to get the biomarkers set. We have to define what biomarkers we want to use to assess therapeutic efficacy. This is still being debated. You and I have just discussed this. What are the best biomarkers to assess therapeutic efficacy? Are the patients achieving these zones? Are these people entering or not entering the zone? What are the limitations? What are the compliance issues? How do you select patients that are going to be compliant?

There are so many different issues that we need to do. This is at the very beginning of a new form of treatment and people need to vet all the variables so that we can then do a trial where we have control for

all of the things we think are going to be the most important for assessing therapeutic efficacy and then launch forward. It's not like a drug. It's very hard to do double-blind, crossover studies with these kinds of therapies.

The pharmaceutical industry has established the procedures that all other therapies must adhere to. But when you're doing these kinds of therapies, you have to be very careful, because somebody's going to know whether or not they're getting a fat diet or a non-fat diet. How do you do double-blind crossovers? All of these kinds of things need to be discussed and launched.

Now, we're stumbling around with a few clinical trials, which is good. So, that's happening. That never happened before. There's a strong scientific basis for this if people really understand the biochemistry of what's going on. And eventually, more and more people will come online, and it's going to be a move. It's gradually going to take place, and then there's going to be anecdotal reports all over the place about people who've managed their disease using metabolic therapy and avoided toxic treatments. It's going to take time, but it certainly will happen. I have no doubt in my mind that it will happen.

DM: With that perspective, let me give you a bit of information on my perspective. I've been passionate about technology, in addition to health, for almost 50 years. I took my first program, advanced class FORTRAN and COBOL (common business-oriented language) in 1968. Then I got my first computer in 1985. It would have been sooner, except I was in my medical school and residency training program, so that's when I finished. Then I got online in 1995, about two years before I started my website.

But, I can tell you from my perspective now that (I've been online for 20 years, actually 21 years now, because I got in on 1995) everyone knows how pervasive, how enormously encompassing intertwining the Internet is. Our life would never be the same again. If you can just imagine back prior to 1995 how your life was compared to this now. I mean, it's the Internet. Well, it's the Web/Internet, because the Internet started in 1968 with Defense Advanced Research Projects Agency (DARPA).

I think that's the same situation. I've got the same I feeling I did in 1995, that we are in the threshold of an explosion of clinical intervention that's going to change the history of medicine. Literally, we'll change the history of medicine. We don't have time to go into the details now of what that is. That's why I'm writing a book. By word of my commitment, I'm going to finish that book.

Hopefully, you can use it as a part of the processes as we start getting these feedbacks, an example of feedback of all these success stories, so that we can design the clinical studies that will prove them and rapidly accelerate their adoption of this. So, literally, those 1,600 people don't have to die every day needlessly.

TS: I agree.

DM: Needless pain and suffering. If you want, *The Fault in Our Stars*, it's really a phenomenal movie that will just drive that home on steroids.

TS: That's great.

DM: You've got to know why. Once you've got the emotions behind you, you get going and you have a reason to do this. I have actually applied this myself. I know it works. I've refined the protocol. I'm not talking out of my butt. I'm talking about practical anecdotal observations.

In my knowledge of 30 years of health and medicine – applying that, integrating that, and developing a protocol – that works using very simple foods and using biomarkers like the daily fastings to target, guide your therapy, and customize it.

I'm beyond excited about this, because I think it's the most important thing I'll ever do in my life clinically: to contribute to this field. I'm so grateful for your part and for contributing to the process of opening our eyes to this truth.

TS: Thank you.

DM: That is a great work. So, anything else you want to close on or kind of rant on for a while? Can you summarize and give your recommendations?

TS: No. I think we've covered a lot of bases and we could talk more about this. But I think we've covered most of the things. I know I've had some people contact me who have watched your programs and who have implemented some of these things.

Gordon Emmerson, I think, is one of the guys. He has remarkable insight on this whole process. He and his wife have experienced health benefits from some of these things. Again, these are anecdotal reports.

Our goal is to write up peer-reviewed publications on this, and this is what I do. I think, the more these get out into the literature, the more things will change.

DM: One of the things that I was negligent in mentioning is your enormously valuable contribution to the literature, which was a book really. It's a brilliant textbook, so it's kind of pricey. It's over 100 dollars or maybe 80 dollars on Kindle. But the title is *Cancer Metabolism*, isn't it?

TS: *Cancer Is a Metabolic Disease*.

DM: *Cancer Is a Metabolic Disease*. Great book. It's available on Amazon. If you really want to dig deep into the details, you can. We're going to put a link that summarizes most of that on a paper that you wrote, which is open-sourced and which is available on PDF. That's a really good paper. I think it's maybe 5 or 10 pages. It really highlights the details from your book.

With my passion and your knowledge, we could talk about this for 10 hours and not exhaust the topic. There's just so much to discuss. I mean, there really is. There are so many [inaudible: 1:09:11] that we can take and everything. But people only have a limited tolerance for this. Don't get discouraged. I'm writing all this stuff up and putting it all together in this very easy-to-understand and implement program. It'll be available later this year.

TS: That looks good.

DM: Okay, all right. Thank you so much.

TS: Thank you.

DM: Hopefully, we've inspired more people to seriously consider. Because you know, I didn't get it last time. This is my life's work, and still, the light bulbs didn't go up until I read Travis' book. It was just like "Bang, bang, bang." It's like someone hit me in the head with a baseball bat. I finally got it.

[----- 1:10:00 -----]

TS: I think it's happening. More and more people come to this realization. Yes, you're absolutely right. This is when things will really start changing. As I said, this is the tipping point. It is Dr. George Yu. He's been behind this, and Dr. Joseph Maroon at Pittsburgh. There are a lot of physicians that are coming on board. I think things are going to start changing for the best and for the success of people. They're too many to mention.

DM: Too many people are dying needlessly, but don't have to. It's just crazy. Just out of ignorance. The knowledge exists. The information is there. It's just a matter of applying them. There's no doubt in my mind that this will go onward. All right. Thank you so much.

TS: Thank you.

[END]