Glyphosate Toxicity And Neurocognition ? Transcript

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Introduction and Speaker Background

Welcome back to the Reverse Alzheimer's Summit. I'm your host, doctor Heather Sanderson. And I'm so pleased today to welcome Doctor Stephanie Self, a senior researcher and scientist at MIT Computer Science and Artificial Intelligence Lab in Cambridge, Massachusetts.

She has a bachelor's of science from MIT in biology and a master's in science and PhD degrees from MIT in electrical engineering and computer science.

Her recent interests have focused on the role of toxic chemicals and micronutrient deficiencies in health and disease, with a special emphasis on the pervasive herbicide glyphosate and the mineral and, excuse me, glyphosate and the mineral sulfur.

Since 2008, she has authored over three dozen peer reviewed journal papers on these topics, many of which I've read and apply in my own clinical practice.

She is the author of a book on glyphosate titled Toxic Legacy How the Weed Killer Glyphosate Is Destroying Our Health and the Environment. This was released in July of 2021 by Chelsea Cream Publishers.

Doctor welcome. It's so great to be here. Thank you for having me. So let's dive right in. For those who don't know what is quite fuzzy and why do you think that this is an important topic when we're talking about Alzheimer's disease?

Glyphosate is the active ingredient in the pervasive herbicide roundup, which, people can get down at the hardware store or the garden store and use on their dandelions in the yard or on the weeds in their walkways.

Very commonly used there, but very extensively used in this in agriculture, especially since the introduction of what they call GMO roundup ready crops, which are crops that have been genetically engineered to resist, glyphosate.

So you can just spray the chemical all over the crop. It doesn't die. Have reached, very convenient way to control weeds. So it was heralded as a great breakthrough in agriculture back, really first, patented, first introduced on the market in 1974.

So it's been around a long time, but really accelerated usage starting about the turn of the century with the introduction of these Roundup Ready crops corn, soy, canola, sugar beets.

These are all, you know, resistant to glyphosate. So they're heavily exposed. And there's also a bunch of crops that are sprayed right before harvest as a desiccant kills the crop.

And that's actually a very serious contribution of glyphosate contamination in our food. Some of the highest levels have been found in the foods that are sprayed right before harvest, including like garbanzo beans and chickpeas, oats and wheat, you know, and so wheat, toxicity I think, is the glyphosate a major, cause of the, celiac epidemic?

We've seen gluten intolerance today. So, you know, it's really, the government thinks it's perfectly safe for humans. They don't bother to test to see how much is in the food.

Others have tested various, you know, environmentally conscious, advocates. And, and Canada has done extensive, testing under pressure from a friend of mine, Tony Mutua, who's been an advocate for a long time.

He got them to test thousands of food samples, both in Canada and imports from, us and other places. And they found, consistently highest levels of glyphosate in the foods from the United States and Canada.

So it's in the food, which I think is a major source of toxicity.

Glyphosate Exposure in Food and Environment

But it's also sometimes in the water supply, sometimes in the air, nanoparticles in the air, these are other sources of exposure. So we really can't avoid glyphosate.

If you live in this country, very difficult to find a place where you can avoid a completely and, and, and of course, the government thinks it's safe and therefore they're not worried.

I think it's not safe. I think it's extremely not safe. And you can read my book to find out why. Well, let's talk through a couple of the reasons why.

So you have described, in your papers that a glyphosate does cause proteins to mis fold. And so when we think about how proteins and, you know, right, there are things that are there are proteins in the brain associated with dementia.

And then we have glyphosate that looks a lot like glycine, which is one of our amino acids. And so just walk us through step by step. Why that can be problematic. Absolutely.

And this is what I think is the very critical, insidious, cumulative toxic mechanism of glyphosate that makes it harder to spot because it's slow and it accumulate, accumulates over time, very, very dangerous.

Glyphosate accumulates in the tissues. And I have a whole chapter in my book explaining the evidence that I see for this idea that glyphosate, actually by mistake, is taken up by the enzymes that assemble proteins.

They mistakenly pick up glyphosate when they need to get glycine, and they put it into the spot where glycine is supposed to go in the protein. If this is true, it's devastating in terms of the potential consequences of it and identified in my book a specific, you know, what I call a glyphosate susceptibility motif, that certain proteins have an increased likelihood of choosing glyphosate over glycine in certain spots.

That turned out to be extremely important for that protein's function. So I've actually been able to identify a set of proteins, that would be predicted to be susceptible to this kind of, substitution of glyphosate for glycine that would cause them to misbehave in dramatic ways.

And in particular, you know, think of Tor, in Alzheimer's, phosphorus to chow Chow has some 80 places where it can be phosphorylated and phosphorylated.

Tau is highly associated with glyphosate. When it gets phosphorylated, it doesn't attach to the cytoskeleton. It gets into the cytoplasm, becomes very toxic.

It's associated with Alzheimer's. I wrote in my book about the evidence that would support that if you substituted a certain glycine in the place where it binds phosphate, the enzyme that puts the phosphate on the tau, these are called kinases.

And there's lots and lots of them that put phosphates on things. You know, kinases are very important and silent in the body. And those kinases can be predicted to be over zealous in yanking the phosphate off of the ATP.

And so that's a limiting step in the protein. They're going to be overzealous in phosphorylated things. And on the other side you have the guys who take the phosphate off that the de phosphatase.

And those also have a particular glyphosate susceptibility motif that's going to disrupt them so that they can't take the phosphate off. So the combination is excessive phosphorylation.

Systemically. And certainly in the brain, tau phosphorylation is going to be a big problem. So that's one aspect.

Then you have the amyloid beta, which is the misfolded proteins that, you know, accumulates in that plaque.

And amyloid beta has a unique motif. And x x x t x x x T motif that is characteristic of of what it's called prion like proteins. And that motif has been that spot in the protein has been identified as the place where the vulnerability is to misfolding.

So normally amyloid beta makes these, these, alpha helices that then goes into the membrane, but with that particular sequence is disturbed. In fact, they've shown experimentally, if you substitute for some of those glycine, the G actually that's three guys.

And if you swap out glycine for something else, it will disrupt its ability to form the alpha helix and cause it to form a beta sheet and status soluble beta sheet, which then gets into the cytoplasm.

And eventually enough of those accumulate, they clump together and they form the plaque. So I think there's a direct hit on both the chow and the amyloid beta connected to Alzheimer's exposure connected to glyphosate exposure to then induce Alzheimer's.

And so clinically, I will just say this is anecdotally right. I haven't done a controlled trial on this. However, I see patients with the severe ALS, Parkinson's, dementia in my practice.

And now, although not all of them, many of them have very, very high levels of glyphosate that we tour on on labs. And when I see a glyphosate, the normal range is below 0.350.35.

And on this test, sometimes I'm seeing people at six and seven and really, really high levels. The typical person, who I see that's relatively healthy is my glyphosate levels are below one, but over 0.35 because, as you said, it's so ubiquitous.

It's really, really challenged genes to avoid. And even when you're eating at 100% organic, however, we still want to encourage people to make these decisions, to try to avoid as much of it as possible.

So for a layman, I want to make sure that everyone's picking up. You're this super, super smart. Am I here? And so I want to make sure everyone's understanding that essentially what's happening is that amino acids are like.

I think of them like strands on a pearl and a string of pearls and then you get a peptide which is your your strand of pearls. But the pearl itself is an amino acid.

And then when we start to fold that strand of pearls together and we make a structure like a 3D structure, it's that's a protein. And these proteins, they only work if they are folded in the right ways.

And so we're doctors. And if it's describing here is protein misfolding. That happens when glycine one of these pearls one of these amino acids is subbed out.

There's a substitution for glyphosate because there's glyphosate in our bodies.

Protein Misfolding and Alzheimer's Mechanisms

And that that leads then to protein misfolding which can be associated with dementia directly associated with dementia potentially. Right. And guy right.

That's beautifully said. That's very elegant and that's correct. And and I just want to point out that glyphosate is a complete glycine molecule. It just has it's actually a pretty simple molecule relative to some other poisons that are, in our environment, a complete glycine molecule, except that it has an extra methyl phosphate unit attached to its nitrogen atom.

And when the proteins are assembled, the nitrogen has to stick. You have a socket that perfectly fits glycine.

Glycine is the smallest amino acid. So if you can if the protein can make a socket, it's crowds out all the other amino acids.

Only glycine fit. That's how you make it. Make it specific to glycine. But the nitrogen has to be outside of that socket because it has to hook up with the paper dolls that are connecting up.

So the nitrogen can afford to have this extra bulky piece on it, as long as they're sort of small amino acids nearby. And so so that's a constraint. If you have about, another glycine to your left, you're especially vulnerable to glyphosate.

Or if you have an allergy, which is also a very small amino acid, you need to have room for that methyl phosphate outside of the socket. But the socket fits beautifully.

Glycine glyphosate matches perfectly in the spot where glycine is supposed to go. So it's just the issue of the of the constraint of the extra bulk of the piece.

It's attached to nitrogen that might prevent it from happening in certain circumstances. If it was too big, amino acids next door, probably wouldn't fit.

But yeah, I can understand. I can predict the circumstances where it would be encouraged to go, particularly if there's a a binding to something like phosphate.

The enzyme, when the enzyme bonds binds phosphate at that site where the glycine is highly conserved. Which of many enzymes do that phosphate has to fit in the substrate.

So that gives you the room for the methyl phosphate, which is about the same size as phosphate. So those are the critical ones, the ones that bind phosphate at a place where glycine is highly conserved.

That's my glyphosate susceptibility motif. And I've shown that several enzymes that match that motif, or I've been shown experimentally to be suppressed by glyphosate.

I wish we had a whiteboard so we could draw their diagrams in your book. So I will refer people to that. Tell me a little bit more about your background because it's a little unexpected, right?

You are essentially now an advocate, against glyphosate in the environment. And you are associated with MIT, but your background, it's biology, it's electrical engineering.

There's computer science, artificial intelligence. And maybe it's this unique pattern that gives you this unique perspective. But tell me, connect the dots a little bit for us.

Yeah. I've wondered whether my computer science training has allowed me to look at biology in a different way from what the way a biologist might look at it.

It's possible that that's the case. I, I've always been fascinated by biology. And, computer science turned out to be a very convenient, choice for career path, and I, I enjoyed the work I did with writing a lot of code to produce systems that you could communicate with a computer using natural speech precursors to, Amazon Echo and, and the iPhone, Siri, iPhone.

So those two products now, you know, we did the very early work in that space, which was really exciting and I enjoyed it. I got concerned about autism around I was concerned about autism for a long time, but especially around 2005, 2006, 2007.

I saw the rates going up every year. And I was frustrated that, the story was genetic. You know, it's just this genetic susceptibility and, define which genes that are that are being, you know, effective genetic mutations.

Nobody very few people, very little money was being put into looking for, environmental toxins that might be associated with the autism. So I wanted to do that.

And I just use my, you know, my skills in sort of data analytics, looking at trends in diseases. And, I work together with Nancy Swanson, doctor Nancy Swanson, she's a physicist.

So both of us are sort of, you know, more into the mathematical space of being able to do statistical analysis and look for significant correlations and just grabbing data, you know, readily available data from the web on disease trends over time and then looking at, chemicals in the environment that would also be going up dramatically.

And, and glyphosate was just a homerun. I mean, it was just amazing. I was looking at, you know, that lab was going down. So that probably is a contributing factor to autism, but it's not the one that's causing the epidemic.

So that kind of thing, eliminating things because, they weren't going changing the right way. But glyphosate is going up dramatically over time. Exactly. Perfectly in step with the rise in glyphosate and a rise in autism in the children.

And also, by the way, with the rise in Alzheimer's, Alzheimer's has also been going up dramatically over time. Exactly, perfectly matched to the rise and rise over time of glyphosate usage, adequate crops and a long list of other diseases.

Too many of them are, neurological, new, you know, neurodegenerative diseases. So this creates correlation in time. And what are the next steps that we would need to take to kind of move the scientific community and the government?

Like, as you mentioned, the government doesn't think that this is harmful. So in order to prove causality, what would we need to do? Yeah, exactly. Well, that's what I was thinking.

You know, correlation doesn't mean causation. They were screaming that, you know, correlation doesn't mean causation. Lots of things are correlated. Who cares?

You know, and so certainly it's a first step if it's not correlated is probably not the cause. So you eliminate it. But if it's correlated now you want to look more deeply.

So I got really interested in glyphosate because of its perfect match. Nothing else was matching anywhere near as well. And it's pervasive. It's in the food supply. It's something kids eat.

A lot of the processed foods that are highly contaminated with glyphosate. So it made made sense to me that they were being exposed. And, and of course, I only immediately identified the gut issue.

And, you know, gut dysbiosis is a big deal. Now, lots and lots of papers are being, published on, the gut problems that people are having and the link between gut dysbiosis and disease.

Like, for example, Parkinson's disease is very closely tied to gut gut dysbiosis and got problems and autism is chewed. I was seeing, you know, from I was reading all about autism and I saw this.

I really had reached the point where it's got to be something in the gut. It's got to be something in the food, you know, so something that you're eating because it's the gut.

And, and getting to that point and it just happened to be serendipitous that I heard a, lecture, in a conference that I happen to be at on glyphosate and I didn't know, I didn't know the word at that time.

This was like in 2012, and, and I was blown away by the lecture because it was, it was so, it matched so well with my, with my understanding of what what was going on with the autistic kids in terms of the, glyphosate disrupting the gut microbiome.

And then, that's causing, different metabolites to be produced by the, pathogens that are then affecting the brain and also the disruption, of the of the, minerals, iron and zinc and and, manganese and, cobalt.

And these minerals were being, grabbed by glyphosate because it's a very strong key later. And therefore the gut microbiome was not able to get enough of these minerals to be healthy.

So it became very imbalanced. And and you could see from studies on glyphosate and which, which microbes it affects, those are the same ones that are depleted in association with autism.

The ones that are robust against it are the ones that are overgrown in the gut, in the autistic gut, like these Clostridium species that reproducing toxic metabolites that are then affecting the brain.

And so, and then there was also this issue of sulfur, which I really, grabbed on to early on in my study of autism. I appreciated that the autistic kids have a problem with sulfur.

They don't metabolize it correctly. And in particular, they basically, flush sulfate through the urine and have insufficient sulfate in the blood and throughout the body.

Something wrong with sulfate? I zeroed in on that early on, and by the way, that's also true for Alzheimer's. Very, very interesting. I've been studying, I read a whole bunch of papers by Professor Hahn and, colleagues at the Washington University in Saint Louis, Missouri, really fat.

And and let's go back to the 1990s. And they noticed, a severe deficiency in sulfur tide in the brain in connection with Alzheimer's disease, which was very fascinating to me.

Sulfur tide is the only sulfur needed, single lipid. And, and so I was very, very interested in, I had gotten interested in cholesterol sulfate to begin with.

And autistic kids, this is a condition where you have a genetic mutation that you can't get the sulfate off of cholesterol sulfate. And that condition is associated with a very high rate of autism.

So I suspected something about cholesterol sulfate being important. And then this sulfur tag, which is this other sulfate, single lipid.

Gut Dysbiosis, Autism, and Sulfur Deficiency

And so I got to think in terms of, insufficient, supply of sulfate to the brain as a consequence of impaired, enzymes in the process of, of getting the sulfate to the brain, making the sulfate, looking it up to something, traveling in the blood and unhooking it, I had to get to the like, okay.

Like, you know, all these steps involve enzymes that bind phosphate sites where glycine is highly conserved, pretty much all of them. So I think the glyphosate is wrecking the entire cell phage system in a big way, and that all of us are deficient in sulfate systemically in this country, I suspect.

I bet you every one of us has a deficiency in sulfate. And sulfate is so, so important, for so many things. Yeah, it's just amazing to me. And I'll say there's there's so many directions I want to go here.

But when I had never heard that glyphosate was a killer. And so that it sounds like it directly affects the microbiome in the gut, but then you can start to think about second order effects and third order effects that if we're not absorbing minerals, well, now, we don't have the factors for mitochondrial function, for candidate synthesis, for for neurotransmitter metabolism.

And so you can see how this these are going to do well I guess indirectly, but very quickly start to affect the brain mood. Like you're saying autism neurodegenerative neurodegenerative disorders.

And one of the things I hear you kind of sharing here is that what you found was true for autism is also true for dementia. Quite likely. And so it's like autism is also almost a dementia earlier in life, or dementia is almost like an autism as we age.

I am curious about this. I want to break down the sulfur tide and you are clearly a chemistry expert. So sulfur like our sulfur, you know, our antibiotics.

And then you've got like, sulfites and wine and then you've got people who have sulfur allergies or sulfur sensitivities. And then I hear you saying, you know, there's probably an epidemic of sulfate deficiency.

Did I say the right one? It did. So I can say sulfite toxicity and sulfate deficiency. And that's because these enzymes that carry the sulfate, along, you know, take sulfur, make sulfate, and go on to move and move the sulfate around.

You basically have two sulfates. Interesting. Because you have to it's hard to transport. You have to, hook it up to something, typically in a molecule with rings, you know, with these rings like these benzene rings, you hook it up to one of those molecules and you ship it up, Kerry being carried by one of those molecules.

And then when you get to some destination, you drop it off, and you typically can drop it off in the glycol calyx in the bike. Okay, Alex, is this complex sugar complex sugar structure that lines all the blood vessels and they are populated with heparin sulfate can do it himself at the sulfate glycosidic glycans.

They have big names, but, those glycol lipids, you know, in the attached lipids as well. I mean, it's all connected together with this stuff that makes structured water around it.

So the gelled water turns out to be a critical, critical aspect of biology that is created by those sulfates that are attached to those like lipids, glycol, proteins and glycol, all these glycol things that have these sugar chains attached to them.

And, when there's not enough sulfate, there's trouble. It's just like the fourth phase of water that it is. It is exactly that. And I read I read both of his.

He has two delightful books that are, meant for the lay public, and they're really great with a lot of, diagrams and things. Now, fourth and there's a fourth phase of water, and then there's cells, gels and engines of life.

Both of them are excellent books that, Jerry Pollock has written. He's a friend of mine. And then I certainly have followed his work, and and this whole concept of the importance of sulfate, in my opinion, sulfate is critical for maintaining the the structured water.

And the gel water creates a battery. If you've read his work, it creates a battery, it drives proteins out and ends up negatively charged. And it's also this sort of like almost like liquid.

I call it liquid ice. That very structured water that is exclusion zone water keeping things out. And that means that all the stuff that's running around in the blood is not going to affect the, the, the blood vessel wall because of this shield that's made out of water, but is only maintained because of those sulfates.

So when you don't have enough sulfates, the shield breaks, the cells get exposed to oxygen, glycation damage all these things, and they get them. They get, broken.

And you have injury of the of the vascular wall, which that of course causes all kinds of things. So what do you know of good food sources of sulfates, not wine, right.

Not lions, but right where sulfate. Well, that's the issue because, because sulfate, as I said, sulfate doesn't travel well by itself. So the critical thing is to have sulfate carriers.

And there's a lot of those. For example, tryptophan. Tryptophan goes, makes serotonin and tryptophan and

serotonin are both so feted when they're shipped around.

All of those neurotransmitters are sulfate. You know, you have serotonin, melatonin, dopamine, adrenaline. All of those are so faded in transit and of course, cholesterol is also so faded.

And I've written a lot about cholesterol sulfate. I believe it's critical, both for heart disease and, for autism and other neurological diseases. Cholesterol sulfate is a fantastic way to ship around both cholesterol and sulfate.

And when you can't make cholesterol sulfate, you've got a big problem because you're going to have a deficiency in both of them. So cholesterol has to be packaged up inside lipid particles.

And those lipid particles actually depend on cholesterol sulfate in their membrane to keep them safe in the in the blood. So we have this whole thing with elevated serum LDL.

You know, the LDL is the so-called bad cholesterol. And you've got to take a stand because your whole deal is high. And actually it's so small, dense LDL particles that are especially damaging because they, they get oxidized, they get glycated, and then they cause inflammation, the artery wall.

And that can be in the heart as well as in the brain, you know. So anywhere actually inflammation in the artery is going to cause inflammatory diseases of all sorts.

And so it's all I think because of insufficient sulfate in the membrane of the other lipid particle that doesn't allow it to be protected from oxygen and sugars that are just traveling in the blood, it's the toxic, glutathione here because that has a sulfur group.

And then also as an antioxidant. Absolutely. Yeah. What do you see? The wrath of glutathione being here. Essential. Essential and also problematic because glyphosate is disrupting and because glucose ion has a glycine.

I don't know if you know that it's three amino acids, stuck together. So, tri peptide, it's called and and it has glutamate, cysteine, which is a sulfur containing amino acid in glutathione.

And then it has glycine. And I'm suspecting that it's getting glyphosate substituted for it's glycine because glyphosate causes, an increase in the liver.

They've shown studies with rats that it will cause the liver to produce excess amounts of a of an enzyme called gamma glutamic trans peptides to get. And that enzyme is quite interesting because it takes glucose ion apart into its individual amino acids.

It undoes the glutathione molecule. And I suspect that it could be that, incorrect versions of glutathione making or getting made that have glyphosate instead, and therefore they have to be disassembled.

Try again to hope not to get glyphosate next time. The reason we run gtis on most patients as a sensitive, liver marker. And so what I hear you saying is that an elevated GTI could indicate a lack of glutathione odor, at least a glutathione that wasn't going to be as productive.

It'll do. It'll remove glutathione. It'll deplete. Good assign because it takes good as an apart. And, and I think it's and I think it's elevation is an indicator of glyphosate toxicity.

It could be I mean, other things can cause elevated GTI as well, but it is a very good marker. It's a good marker of a lot of things. Even in cancer. I wrote a whole paper on GTI, together with a colleague.

And it's it's quite interesting. And it's an excellent marker of liver disease, even heart disease. Cancer. You know, a number of things. I don't know about Alzheimer's, but, can we take glycine to help to get rid of glyphosate?

I think so a lot of my, practitioner friends are recommending glycine and finding that it's working well for their

patients to take glycine as a supplement, and certainly to eat glycine containing foods.

One thing that's good is, organic, beef, beef broth. You know, bone broth. Bone broth is, I think, a very healthy, nutrient, because it has a lot of good things in it, including minerals, but it also has, glycine because there's tons of glycine in collagen.

And this is another thing that I've, I'm concerned about is collagen. Collagen is the most common protein in the body. So something like a 25% of the protein in your body, your collagen molecules.

And collagen is the glue. You know, that's what's in your joints, in your bones, in the tissues. You know, it's sort of the in-between stuff of your that holds you together is collagen.

And, collagen is a has a long, long sequence of why every third amino acid is a blazing, extremely glycine rich, protein, which makes it extremely susceptible to glyphosate mischief.

And I think a lot of the things we're seeing so many people suffering from, you know, bone pain and joint pain and, back pain, you know, issues with their elbows and, and knee replacement surgery and hip replacement surgery.

We see all these people hobbling around as they get as they age. And I think there's accelerated aging in that respect. And physical disability, because glyphosate is messing up the college and it's going to be accumulative over time.

So it's going to get worse and worse as you age. And also, as you mentioned, with kiddos who are eating a lot of, wheat rich foods high in glyphosate.

The same thing happens to our elders right when we ship them off to these memory care centers or senior living facilities where they're in front of TVs, having cereal for breakfast, pasta for lunch, and sandwiches and ice cream after dinner.

Right. That we're just feeding them more of the toxicity, not just the sugar, but with this GMO and glyphosate spray foods. Right. I think one of the most important things at any facility that's taking care of Alzheimer's patients should do is to switch their diet to a certified, organic, whole foods diet.

I think it would be the best thing you could do for those patients. That's they're not doing that how you do that. Yeah, we I have I have a residential care facility for the elderly.

And that is exactly marvelous. We have an organic ketogenic diet as our base diet is fantastic. And ketogenic is also extremely interesting. And I'm aware of the benefit of ketogenic.

In fact, I remember, coconut oil was being recommended and that's an interesting oil. I looked into that some time ago, actually, because I had heard about coconut oil.

There was a woman who had the story, I think, about her husband and, and so, it's an interesting oil because the coconut, oils are medium chain fatty acids, not long chain, not short chain, but medium chain and long chain fatty acids get packaged up.

You know, they, they get packaged up in title micron and they get shipped through the lymph system, and finally they rise to the heart. Actually, the heart gets first dibs on them.

And the heart loves that. The heart actually loves fat. You know, it's funny how we think high fat diet is bad for the heart. It's the opposite. High fat diet is good for the heart.

Because fats are a really healthy fuel. I'm getting a little bit distracted here, but the the fat that's in the coconut oil is a medium chain fatty acid.

It actually gets sulfate in the gut, and then it gets shipped directly to the liver. It doesn't go into the kind micron. It is supplying sulfate to the liver, which is so important because our livers really I think grand Central for sulfate distribution.

Well, so so coconut oil is a way to is and something we could eat that would also more more sulfate exactly help you to get to sulfate levels up. So I think that's an interesting, reason to, to, to take a coconut oil.

Sulfate, Cholesterol, and Glutathione

So there is some conversation around ApoE e4 and saturated fats. Now you understand the chemistry very, very well. And there's a connection between sulfates and apo E4.

Can you again help us connect those dots. Very very interesting. And this is I mentioned that listen, you know, Professor Hahn, Washington University sulfur tide.

He found they have found extraordinary things about Alzheimer's. And it kind of annoys me that their, their research is not being picked up, as far as I can tell, by others, because it's really amazing research stuff it's hard to work with.

So I think a lot of people don't choose to research the time because they don't quite understand how to how to do it, but there's group is highly skilled with analyzing this alpha tide levels in the brain.

And they found Alzheimer's disease was associated with a 90% reduction in sulfur tide in the gray matter early in early on as a as a very beginning of Alzheimer's or even before the Alzheimer's symptoms appeared.

Already 90% reduction in sulfur tide in the in the gray matter, which is sort of the neuron body's, you know, sulfur tide also was depleted in the in the white matter, which is more of the sort of myelin sheath.

There's lots of sulfur tied into my, my, sheath. But there's also sulfur tide in the, in the, lipid, what do they call oh, shoot. A loss of term. This is special areas in the in the cell membrane that are, concentrated the sulfur tied in the neurons and said sulfur tide is very important for neuron health.

And, what's happening is that the immune cells. So there's inflammation in the brain, and the immune cells are actually stealing the sulfur tide from the brain, from the brain's, system, from the brain cells and depleting the cell in the brain.

They're stealing it. It's very, very interesting. And, I suspect they're stealing it because they need it, too. And they're deficient. I think your immune system is really God in your body.

If you mean system's not working, you're going to just die of some infection. So it has to take priority over everybody else, and it knows how to go in and steal stuff, you know?

So it'll just go right in there and help itself to the cell with that, because the immune cells need the cell for tide to stay. Just stay healthy. And, and so I think that's really, really fascinating.

And the thing is ApoE e4, he did a lot of looking at the. Yeah. These really highly, highly sophisticated experiments where he, he made all these different kinds of mice.

They can do lots of weird experiments with mice where they get them to make human proteins, and they were able to make mice that had, you know, defective AP e4 that had, excess human ApoE two, ApoE three, ApoE4 and compare all of them with each other.

And they found that the mice that had this human in four in particular, had severely depleted sulfoxide in their brain. It took away this update. ApoE e4 is involved in this stealing of the cell type, and it does it much better than the other APIs, which means which to me means central to Alzheimer's is suffer type deficiency as a consequence of

the stealing of the sulfur type by the immune cells from the brain.

There also seems to be a role with ApoE e4 for especially and fat metabolism or cholesterol metabolism. Do you have any insights there? I looked into that first. Actually.

I was very interested in the Oppo E4, and I've written some papers about it as well as an blogged, you know, blog articles. About Apple E4 and its connection to, to cholesterol and metabolism.

And, you know, these things are complex and it's sort of hard to get the answers. I think that, what I found was that ApoE4 facilitates, the, the extraction of cholesterol from cells.

And, in particular, I think, it actually, I think was allowing the cholesterol event. I'm actually forgetting. I remember reading about this some time ago, but I forget the details.

It I think it was bringing the cholesterol into the, into the blood, but in an odd way, like not not in the normal way. So something, you know, it's very hard.

I think the real answer with the ApoE4 is with this all the time, not with the cholesterol. That's my opinion. Interesting. Yeah, I'm talking to Doctor Stephen Gundry and he's he's written extensively also about this.

So, get to have both of your opinions here. And it's really appreciate it. You know, I have so much curiosity. You have put yourself out there as an advocate for the environment, for health.

And there's a lot of criticism that comes with that. Yeah, I think I'm I'm beginning to, you know, it's, also being a place where there are people who are highly critical of the work that we're doing around dementia.

And, and so I'm just wondering almost at a personal level, like, how do you get through it? Yeah. I just basically ignore them. I feel, privileged if they're going to attack me because they're going to make me much more noticeable to everybody by attacking me.

Right. And I just basically ignore them. I'm like, fine, if you want to tear apart my work, that's fine. I made it the science. I want to figure it out.

I want to understand how biology works. And these chemicals, these toxic chemicals are actually a great window into how biology works. By virtue of how they mess it up.

You would never have discovered these things. You know how the biology is supposed to work if you didn't have these toxic chemicals to cause it to work incorrectly.

That's gives you tremendous, evidence and tremendous information that's valuable for figuring out biology. And I'm just absolutely fascinated with biology.

That's where I'm centered. I wish I could just hole up in a room and and read about biology all day long, you know? But I find there's urgent messages that I want to get out because I just can't stand the fact that these kids have so much autism.

It's going to get worse. It's gone up again this year. Hardly even any news about it. You know, every year rising, nobody seems concerned. I just don't understand that we have it.

You know, I think it's like, gosh, one in. I think it's even one inch 40 something now, kids with autism, it's just astonishing. There's the argument there.

I be curious, your insights that we've gotten better at diagnosis. It's not actually that incidence is going up. I hear that all the time, and it makes me very angry.

It's just not true. I when I was a child, I never knew anybody with autism and nobody with any autistic symptoms. Nobody, you know, it didn't exist. We didn't have the word in our vocabulary.

And and now you find autistic kids very easily. Almost everybody knows somebody that's got autism or who, you know, somebody in the family has autism.

I mean, it is so in the family. Yeah. Yes. Multiple people in one family. It's just so obvious that there's more. And I find it really annoying that people can't explain away these problems this way by saying life is glyphosate.

Oh, correlation doesn't mean causation. And just say, well, oh yeah, we just diagnosed to get more. I mean, all these sort of, you know, excuses to not look at the problem squarely in the eye and say, what is going on here?

Well, there's also, Sarah Leni out of France. Am I saying his name correctly? I think so, again, I usually read it. I don't say it. He's been targeted quite aggressively.

And so there is not only, this it's convenient, right. But it's inconvenient to avoid glyphosate. It's work. You have to spend more on your food. You have to go out of your way to make sure that whatever you're eating is organic or wheat free or, you know, it just takes effort.

And then when you look. So that's one thing from a, from a public kind of consumer side. And then from a researcher's perspective, no one is, oh, thank God you are.

But there are very few people who are motivated just to find the truth. Right? There's there's financial interest. There are also there's an interest in avoiding being so targeted that and so yeah, I'm curious your experience of that now, that's certainly true.

I feel like most people, you know, if they're trying to keep an income going, they don't want to go near a topic that's controversial, especially if pharma doesn't like it.

I mean, a lot of the funding from the for the agricultural, universities comes from the chemical industry. So don't bite the hand that feeds you. Right?

You're not going to look at glyphosate if Monsanto is the one that is funding your research. So this is a very clever to just fund the research so that you won't, you won't go near their product and keep their product safe from it's, from observations about what's bad about it.

So it's really, really sad that way that we don't have enough independent researchers who are not beholden to the industry, particularly pharma. Of course, pharma has a huge reach, and they control even the journals.

So that, you know, it's hard to get something published if it's going to tear down some expensive pharma drug. It's making a lot of money. Nobody wants to go there if they want to continue to get their funding.

So I think that's a huge, huge problem. Pharma has too much money and they use that money to control the messaging.

Deuterium, Mitochondria, and Ketogenic Diets

And they fight very hard against anybody who steps out of line and starts, you know, saying that their product might not be so safe. And, and of course, the agrochemical industry is almost the same thing.

It's where Bayer now owns Monsanto. So it's all one big package of chemical toxicity, in my opinion, that is sort of, you know, being thrown at us as an individual in a society.

It's extremely hard to stay safe from these chemicals, and live a healthy life. And I think it's important for people to understand that context, that it's not, you know, it's so much more convenient to just explain it away, to say that

correlation isn't causation.

But if they understand that, well, it's easy, challenging to link causation to do the research because of how, again, like how society is set up, how the the dollars flow, who's funding what.

And so understanding that I think can can help us sort of motivate because really when I hear when I read your work, when I hear what you have to say, it's very common sense, right?

Like we have new chemical that is very similar to some of the chemicals in our body. It can substitute for it and it can cause misfolded proteins. It can jam up our biochemistry.

That makes perfect sense to me. There's nothing about that that that doesn't make sense. Right. But then you go to the next step of all right, well, how do you prove causation?

And you see that there's this roadblock and doing any of that. And so then you just kind of say, okay, well then let's just go back to common sense. And eat this.

And I think that in time if you just have people like your patients who carry out this sort of healthy lifestyle change and get better, that becomes extremely good evidence.

And a lot of people like you are busy as clinicians. You don't have time to sort of set up a, you know, controlled study with the placebo group and all that kind of stuff.

You want to just heal your patients, you know? And if you do succeed in healing them much better than the next person stealing their patients, people are going to stand up and notice that right?

Certainly, I hope so. We're publishing our trial on dementia this year. And a big part of that was suggesting that everybody in the trial get on an organic ketogenic diet.

Perfect. Yeah. Doctor Bredesen also published his trial last year showing, the reversal of dementia, about 75% of participants. And part of that was avoiding certainly avoiding these high glyphosate foods through a ketogenic diet.

So where I'd like to yeah. Go ahead. Now, continue. We're starting to put the pieces together. Yeah. It's great. And I want to say something about keto genic diet.

This is something that I've gotten interested in the last couple of years. I don't know if you have heard of deuterium. Do you know what deuterium is?

No. Oh, okay. Great, because you will love this. I got I got approached by, Laszlo Burrows, doctor, Laszlo Burrows, who was, he's from Hungary. He was trained at the Georgia Institute.

And he has a medical degree, and, and he got, he got interested in deuterium a long time ago, and he introduced it to me in December of 2019, I think it was. Yes.

And I was immediately really enthralled by it and, grabbed hold and took off with it because I could see how it would be connected to life is a very, very easily.

So it's just really, really thrilling. And I had a great, you know, pouring over deuterium for a few months before Covid hit. And then I got into Covid and that kind of linked into deuterium, cuz I've been really excited with, breakthroughs in my own research over the past couple of years, in part because of Covid and, you know, just circumstantial situations that are opening up new windows to study things.

You know, when you look at the Covid disease and how that that's also, I think, connected to glyphosate poisoning, which is disrupting the immune system.

And that also connects very, very directly to deuterium. So deuterium is heavy water, heavy hydrogen. Hydrogen is the smallest atom is just one proton and one electron.

Deuterium is a proton electron and a neutron. So it's about twice as heavy as hydrogen. And it's present naturally, in water at about 100, 155 parts per million, which sounds small, but actually when you look at the numbers, it's actually significantly higher levels of deuterium in the, in the blood than there are calcium.

So some of these minerals are also much, you know, lower levels in the blood than, deuterium and tritium turns out to have different properties from hydrogen, as you might imagine, because it's heavier.

It sticks better, in binding. And then it's less likely to want to hook up in these ionic bonds. So the covalent bonds are stronger. The ionic bonds are weaker.

And because it's heavy it tends to stay in the liquid phase. If you evaporate it it'll stay in the liquid phase. So these different properties of deuterium relative to hydrogen, cause different chemistry to happen.

And it turns out that the mitochondria really, really care about not getting deuterium, getting as little deuterium as possible into their inner membrane space.

They really care about that because deuterium is like a big bulky the hydrogen, you know, the proton motive force is what drives the HPA pumps to make the ATP.

That's protons pouring across that. But, you know, they sort of they pump protons into the membrane and then the protons naturally pull, you know, come back out through these pumps, these ATPase pumps.

And that is what makes the ATP. That's the energy behind the ATP. So those pumps actually get kind of clogged up with deuterium. If there's too much of it it breaks them.

And it also causes reactive oxygen species because this whole thing isn't working smoothly anymore. It's like an engine with sugar in it, sugar in the gas tank.

So how do we avoid deuterium and what does it have to do with glyphosate. And it's hydrogen water, something that we should be considering. Get all good questions you can see.

Yeah. I got really excited when I saw this. I immediately realized that. So I started looking at the enzymes. It's actually really fancy biology that is involved with managing deuterium.

The body has this incredibly intricate system that involves a whole bunch of enzymes that know how to make sure their product contains hydrogen rather than deuterium.

They know how to select for hydrogen in the reaction. And in fact, one of them is oxygen is off oxygen. This is an enzyme that, modifies fats and oxygen.

These is known to be nasty because it causes inflammation in the artery wall. You know, it causes inflammatory response, because it produces these, leukotrienes, which are these interesting looking modified fats, that are signaling molecules that cause this inflammatory response.

Well, the oxygen that is very, very good at pulling hydrogen out of fats and replacing it takes away two hydrogens and replaces them with one oxygen. And with those hydrogens, it's able to make deuterium depleted water because it's extremely good at choosing hydrogen and not, deuterium.

In fact, the industry is is is promoting the idea of eating flat fats that are rich in deuterium because then like packaging, those won't react with them, which will reduce the inflammatory response.

It's a really stupid idea because you desperately need that deuterium depleted water that that enzyme is making,

I'm kind of getting ahead of myself because there's a whole bunch of other enzymes that also are able to select hydrogen or vegetarian, and many of those enzymes are ones that are affected by glyphosate.

So there's a whole class called fiber. Fiber proteins and fiber proteins have a particular site where they bind phosphate just as I said, they bind phosphate.

In, in, in, two, interesting molecules nad nicotinamide add new dinucleotide and fad flav and ad nucleotide, both of those. They're related to B vitamins.

The NAD comes from niacin and the fad comes from, fiber, bio fiber plating. Riboflavin, right, is to be the, vitamins B vitamins. Yeah. So nADPh, those are both phosphate containing molecules.

They bind to, enzymes at places where they have highly conserved glycine. So it's like a three glycine unit, characteristic motif at the binding sites for F18.

And I do highly, highly susceptible to glyphosate substitution which messes those enzymes up, which prevents them from doing their job. And then what happens is it's like oxygen.

This has to take over like oxygen. These doesn't have that, those features that make it glyphosate susceptible. And it's extremely good at choosing hydrogen over even better than the flower proteins.

It's a really interesting engine. Highly skilled tissues, only hydrogen, not react with them at all. That's why they can make these deuterium rich fats that won't react with it.

It's the backup system. Once those other guys have failed, that's what I think is happening. So you're getting a lot of trouble with your mitochondria getting piled up with deuterium, breaking the ATP pumps, releasing reactive oxygen species, not having enough energy because it can't make enough ATP.

Mitochondrial dysfunction is connected to all kinds of neurodegenerative diseases and I think it's directly linked to deuterium, toxicity, because the enzymes that would normally fix the problem are not working.

And the other really interesting thing about that is the sulfate, because the sulfate makes the gel water, the gel water pushes out protons, but it pushes out much, many more protons and neutrons.

Reducing Exposure and Fixing the Food System

And that's what it holds on to the deuteron because they tend to stay in the structure. They're not as light, they're not as mobile, they don't leave as easily.

So it's those protons that come out of the structured water. Are deuterium depleted. And they I think they're fed directly into the cytoskeleton of the cells and directly into the mitochondria to supply them with depleted protons.

So they the sulfate system is wrecked by. I like to say that means you can't make as many of these healthy protons and these enzymes that directly deliver, deuterium depleted protons to the mitochondria are also disrupted.

Disrupted by glyphosate. So I think we have a a national issue of, deuterium toxicity as a consequence of glyphosate. You know, in our society, you know, you mentioned I've heard you mentioned inflammation and mitochondrial dysfunction, and I've been at conferences where some will say, you know, mitochondrial dysfunction, this is the cause of everything or inflammation.

This is the cause of everything. And what I really appreciate about your work is that what causes inflammation exactly acting to control dysfunction and you take it that one step back and say, okay, these are the toxins that come into the system and muck up the system and then causes symptoms.

And then of course, like these diagnoses that are these Latin words that are really fancy and really important to

some people. And the the question then is how do we avoid them?

So how we can't avoid them completely. But what do you do? You are one of the people who knows more than anyone about how toxic glyphosate is, right? Oh, do you avoid it?

I want to first say the fats because the fats are actually really good to term depleted foods. It turns out that fats have low deuterium compared to other foods.

Oh ketogenic diet, ketogenic diet. You're getting a low deuterium diet when you eat a ketogenic diet. And I think that's super, super important that people don't realize that.

And, lots of borrows has written about that in his, in published papers that the ketogenic diet is a is a low deuterium diet, and that's why it's healthy.

The other thing I want to say is that the deuterium was first discovered as a toxin by the Russians, and they had, people living up north and Siberia.

They noticed they were living a really long time, like they had a really high longevity, and they were eating really kind of bad food. I mean, they didn't get fruits and vegetables, you know, they're basically eating, you know, meats and fats, animal based foods.

They weren't getting a lot of because they couldn't they didn't have a growing season. You know, that was long enough to get the fruits and vegetables.

And yet they were super healthy, lived to be 110 112, you know, and they were like, what's going on with this? Why are these people so healthy? So people got interested in that.

And some researchers finally traced it to deuterium depleted water because glacier water is naturally deuterium depleted. And that's what they were drinking.

And so then that's become a really interesting it's been research out of, I mean, I know you're drinking glacier water. Well, it's spring water, but yeah.

Yeah, that's good too. Yeah, I like I, I buy a Hawaiian volcanic water and it's also good. So if it's not sulfur as well, you know, Iceland has really good, life expectancy, very low infant mortality.

Iceland. And they've got these volcanoes, you know, with all this basalt rock that's a lot of sulfur, but it's also the glacier water. But it's giving them loaded terms.

And they have both a load yttrium and the high sulfur, which I think is what keeps them healthy. Those are sort of two critical things. The only to supplement that I take this is right here deuterium depleted water and, Epsom salt baths.

Those are my only two supplements. Interesting, interesting. Okay. And then what about lifestyle? I worry about my patients who live in an HOA right where it's being sprayed, and then their dog is out running around and rolling in it, and then the dog comes inside and they're walking barefoot.

Or they're walking outside with their shoes on, and then they wear their shoes in the house. Do you think, should I be worried? I think you probably should.

And I don't know how to stop that. Right. That's what's so frustrating, is people, you know, living next to people who are spraying. I mean, I've been contacted by people, you know, even like an organic farm.

And then you've got these farms all around you that are spraying, you know, toxic chemicals. And how do you keep your organic farm organic? It's just so sad that we have we have to really fix everybody before we can be healthy.

Right? We have to get everybody onto the agenda of converting. I think the most important thing our country could do right now is to get rid of the mega farms and replace them with small family farms that are organic across the board.

Anybody who's young, starting out in life, buy some land, grow some food organically. You know, I was having this conversation last night when talking about prevention and preventing disease.

And where do we start? What's the root cause. And hands down everyone agreed the food system. Yeah. Fix the food system. It's the food. Yes. So cheers to that.

Thank you for doing your part. It's an absolute pleasure. And I'm going to have to listen to this recording about six times to figure out everything that you just said.

And I've read your papers, highlighted notes in the margin and, I, you know, I didn't realize until I got your bio that you had a book. So first thing on my list. So I've got it right here.

Oh, show us. Hold it up. Toxic legacy, how the weedkiller glyphosate is destroying our health and the environment. And thanks so much for making that available to people.

If anyone wants to understand more about what you're doing about your work, where can they learn more? I have a personal web page. Definitely sent. I've gotten it.

It's a starting point, and I have a section there on my book and various links to various places. You can buy my book, as well as, interviews and, papers that I've written.

And it also points back to my MIT webpage, which is a longer thing, but it's got my MIT web page, has tons of stuff. All my papers are available there on my published, peer reviewed papers on my MIT website.

And if you just search my name, even probably just send it, you'll find some people who are claiming that I'm kind of a wacko, but you can ignore them.

There's lots of interviews that you could find just by searching Stephanie sent up or even just sent. It's a very rare name. I see any f and you'll find interviews.

I've done lots and lots of interviews. And also presentations. Well, thank you for doing this one. And, if you're a wacko, then I will join you. Yeah.

Searching for truth and also for using common sense. I thank you again so much for your time. It's it's supremely valuable. And I just couldn't be more grateful to be joining this site with you to help people live healthier lives.

It was really my pleasure. I enjoyed so much talking with you. And thank you for what you're doing to help the Alzheimer's patients. So important. Thank you.

For.