Nutrition to Support Brain Health & Offset Brain Injuries

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Dr. Andy Galpin
The science and practice of enhancing human performance for sport, play, and life. Welcome to Perform. For the final time this season, welcome back, friends. I'm Dr. Andy Galpin. I'm a professor of kinesiology in the Center for Sport Performance at Cal State Fullerton. So far in the first season of Perform, we've talked about everything from muscle to the immune system to liver and lungs, metabolism, genetics, sleep, blood work, and so I thought we have to end this thing on what I hate giving credit to, because I'm a muscle guy, but probably deserves it, and that's the brain. There are obviously many factors that go into getting your brain to perform at its best, but today I want to focus specifically on what you can do from a nutrition perspective to reduce your risk of, as well as recover faster from, brain injuries, concussions, and TBIs. I think it's worth reminding you, though, that if it's good for preventing and returning faster from a brain injury, it's probably safe to assume it's also good for brain performance as well as long-term health.

Dr. Andy Galpin
Now, I'm particularly passionate about this subject, having dealt with it a lot personally. I've had a concussion or two myself, and I've spent much of my career working with athletes prone or at high risk of developing similar injuries. This includes football players, wrestlers, fighters, boxers, and so forth. That said, those are not the only people at risk of a brain injury. In fact, those things are quite common, and not only in athletes. So I'm really excited about this topic because brain injuries are really common, they can be completely debilitating, and there's actually a lot of evidence that nutrition and supplementation can have a big effect in, again, both reducing your risk of getting one, as well as coming back faster once they've happened. And so I really want to make sure everyone knows what their options are from a supplementation as well as whole food perspective on getting back and returning as fast as possible and minimizing the symptoms of brain injuries.

Dr. Andy Galpin
Now, as I was saying, traumatic brain injuries, or what we'll refer to as TBIs, are really common. In fact, a lot of people in the field refer to them as the invisible disease, because they don't come with a physical appearance. There's no cut, there's no bruise or joint sticking the wrong way, bone poking out of the skin. And so these things can happen, and you don't necessarily know

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that an injury occurred. Other problems include the fact that the symptoms that are associated with a TBI or concussion are really similar to those generally associated with aging. So you talk about memory recall issues, mood, sleep, and other things that people don't necessarily know are because of an injury, and they may think it's just due to normal aging. In fact, we'll get into this a lot as the episode progresses, but a lot of the research on brain health with aging, Alzheimer's, dementia, and other related topics, come from the same data sets that we work on for TBIs and concussions, and the inverse.

Dr. Andy Galpin
So there's a huge overlap or Venn diagram between the types of research, the study design, the actual papers themselves, the interventions, the models, whether we're talking about data from humans or animals and rats and ferrets and things like that. There's a large overlap between these two bases. They're different, of course, and we'll try to highlight those, but these are some of the reasons why I want to get into today's episode, even if you're not an athlete, because many of you are still at risk of getting a TBI. In fact, the vast majority of concussions and TBIs do not come from sports. They come from accidental slips and falls and other problems like that. In addition, they're still going to tell us a lot of indirect information about overall healthy brain aging. So the goal here will be to reduce our risk, of course, but if it does occur, to minimize the symptoms and return back to a healthy brain as fast as possible.

Dr. Andy Galpin
Now, before we go too much further, I'd like to take a quick break and thank our sponsors, because they make this show possible. Not only are they on this list because they offer great products and services, but because I actually personally love them and use them myself. Today's episode is brought to you by LMNT. LMNT is an electrolyte drink mix that has an ideal ratio of sodium, potassium, and magnesium, but has no sugar. Electrolytes are critical to proper hydration, which I've been harping on for years, but you can't do that by only drinking water. In fact, many of you will probably remember that I featured LMNT in my YouTube series on optimizing hydration all the way back in 2020, which is obviously long before this podcast even existed. So I've been a fan of LMNT for a long time. In fact, astute listeners will also realize these hydration videos were the genesis of the Galpin Hydration Equation, named not by me, but by the legendary neuroscientist, Dr.

Dr. Andy Galpin
Andrew Huberman. I featured LMNT in these videos because their blend of 1,000 milligrams of sodium, 200 milligrams potassium, and 60 milligrams magnesium really is different than any other electrolyte on the market and has great scientific support. I personally use the citrus and watermelon flavors a ton to pre-hydrate before heading out on a full day of training or a long hike or a hunt, since I know I'll be losing a bunch of fluids and won't have many opportunities to take

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things with me. LMNT has also just released a new line of canned sparkling LMNT, which I am all about. If you'd like to try LMNT, you can go to drinkLMNT.com/perform to claim a free LMNT sample pack with the purchase of any LMNT drink mix. Again, that's drinkLMNT.com/perform to claim a free sample pack. Today's episode is also brought to you by Continuum. Continuum is a membership-only wellness club designed to help high performers reach their fitness and performance goals.

Dr. Andy Galpin
Continuum just opened its flagship club in Manhattan, quickly making it one of the most sought-after memberships in the city. Its location in Greenwich Village is incredible. In fact, it's stunning. It's a 25,000 square foot space with state-of-the-art equipment, a beautiful design And everything you could possibly want in this unique mix of a gym, wellness center, and social club. Continuum members start with a thorough Olympic-grade assessment that results in a biometrically-driven, AI-assisted wellness program that updates in real time and incorporates everything from personal training and physical therapy to hyperbaric and IV therapies. By bringing together true fitness experts, best-in-class technology, and proven wellness services and amenities, Continuum delivers the most comprehensive solution to performance. I've been involved with Continuum, working as their head of performance science, since their founding, and I've been incredibly impressed by what the team there has built.

Dr. Andy Galpin
If you're interested in joining Continuum, their team has agreed to give a select number of you, the listeners here, a fully waved onboarding, which includes VO2 max testing, DEXA scans, blood panels, sleep analysis, and more, all at their fabulous New York City flagship location. To learn more, visit continuum.club/perform. Again, that's continuum, with two Us, .club/perform. Now, before we get started on the details, I want to highlight a couple of things. First, remember, I have a PhD. I am a scientist. I've published in this area. In fact, I have recently submitted a literature review as a co-author, and we'll talk about that later. But I'm not a medical doctor. If you think you have any risk of, or potentially have had or are suffering consequences from any type of brain-related injury, please see a medical professional in this area. Now, I want to focus this episode on nutrition and supplementation related to brain injury, but I also don't want anyone to think that I am suggesting this is all you should do for your brain injury.

Dr. Andy Galpin
I also don't want anyone to think that I'm suggesting this is enough to stop your chances of ever having a brain injury. So that being said, the landscape of the research and many of the scientists in this area are on the same page in the fact that there is emerging evidence that several micronutrients and what we'll call biological compounds really do have the ability to reduce the risk, I hesitate to say prevent, but can help prevent and treat brain injuries,

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concussions, TBIs, and related events. Now, over the course of today's show, I'm going to walk you through a bunch of different micronutrient and nutraceutical options you have. We'll cover the evidence, how much to take, the protocols, and so on and so forth. But before we do that, you have to actually understand a little bit of the terminology, because depending on what type of brain injury you have, you may want to take a different route with your nutrition.

Dr. Andy Galpin
So getting going with that point, what is a brain injury? You've heard me now say concussion, TBI, brain health, and a bunch of different terms like that. What is actually the difference? In fact, do you even know the difference between a TBI and a concussion? It's been my experience that most people don't, and so we'll maybe just start right there. So a brain injury can mean a lot of different things. Honest answer here, there's not that much research in humans, in randomized control trials, on what to do to prevent or reduce an injury. In fact, if you think about research design, that's really hard to do. The only way to execute these kinds of studies in humans is to set up an enrollment center, say, at a hospital, probably around an area that has a lot of kids playing in sports, wait for people to show up with an injury, ask them if you can enroll them in a study, and go on from that. We can't go out and give humans head injuries and concussions, and so it's really challenging.

Dr. Andy Galpin
It's hard to get an adequate sample size, and you're also reliant upon those people coming into the study having the same type of brain injury, and we know that that does not happen. And so brain injuries themself, there's a lot to learn, and there's lots of different types. It would be foolish to think that we know how to prevent all of them or recover from all of them. Some types of injuries we know more about, other types we know way less. And so there's not one type, which means there's not one solution, and this is going to explain why almost always you will see mixed results. Easy example here. We're going to talk about one of the major problems that are associated with brain injuries is sleep. So supplements that help with sleep, therefore, are going to be helpful for folks who are experiencing sleep-related problems with a brain injury. However, if you have a brain injury and are not suffering symptoms of sleep loss, then a sleep aid may or may not actually work.

Dr. Andy Galpin
If both those individuals, let's say we had two people, one having issues with sleep, one not, both enrolled in the same study, you're going to see the magnitude of effect of the supplement or the nutritional factor gets a little bit washed out. So those are common themes you will see. I won't bring this up again because honestly, I could do that with just about every single study, but it's something for you to really consider in the back of your mind. All right? Now, the goal then is to present to you information that I think has a strength of evidence, I'll explain to you what my

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criteria for a strong evidence is a little bit later, and things that I think kind of justify what we'll call low risk and high potential reward. And we'll typically break those down into things you can do before the injury, during or immediately after the injury, as well as long-term post-recovery. So you can think about that as pre, peri, or post, or simply preventative, and then treatments post-injury.

Dr. Andy Galpin
So in terms of terminology, I'm going to try to be consistent with three basic phrases. So a brain injury is often broken up into three categories based on the severity. There's mild, which is the lowest, moderate, and severe. Now, fortunately, mild is by far the most common. In fact, some papers will indicate that over 90-plus percent of brain injuries are qualified as mild. What that means, typically, is there is a 30-minute or less change in state of consciousness. Right? So if you were unconscious for a couple of minutes, you probably had a mild traumatic brain injury. Right? This is often associated with things like confusion or post-traumatic impact amnesia. Right? So you forgot what happened immediately afterwards or you had a little bit of a time travel, as I like to call it. And this can occur for a couple of hours or even up to one day is the general line that we cross there. The overwhelming majority of recreational and sport-related concussions fall into this category.

Dr. Andy Galpin
Therefore, almost always, though not always, but almost always when you hear the word concussion, you can generally translate that into a mild TBI. Now, not all TBIs are concussions, but all concussions are TBIs. Okay? So one more time in case I lost you there. Concussion is effectively a mild traumatic brain injury based on those categories. If you had worse effects, so you were unconscious for longer, or your amnesia lasted longer, then you may actually be considered to be in a moderate category. So moderate, technically, is defined as a loss of consciousness or amnesia for somewhere between 30 minutes to up to 24 hours. Symptoms associated with this are more severe. It is headaches, confusion, dizziness, nausea, vomiting, slurred speech, drowsiness, difficulty concentrating, so on and so forth. And so another kind of back-of-the-envelope way to differentiate between mild and moderate is mild, again, not always, but rough guidelines here.

Dr. Andy Galpin
Mild is fairly acute. So in and immediately after the injury, you had symptoms, but then you're usually back to normal. Moderate often comes with downstream problems, not the injury themself. So this is when you have behavioral changes because of the TBI. You've got, again, difficulty with memory that lasts a long time. That's, again, back-of-the-envelope kind of distinction. If it is worse than that, we call it severe. That is technically a loss of consciousness or amnesia for somewhere between 24 hours to up to or more than seven days. And moderate and

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severe also have similar dementia-like symptoms. Now, I mentioned this earlier, but think about this. Severe TBIs oftentimes come with memory and attention problems, decision-making problems, learning impairments, mood, big sleep disturbances. And so you can imagine somebody who's in their 50s, 60s, or 70s who start experiencing things like that, they may personally just think, "Oh, I'm getting old."

Dr. Andy Galpin
Family members may think, "Oh, Grandma's starting to show dementia signs." Could be possible. Could also be possible that Grandma's simply suffering from a severe TBI. And so this is what I was referring to earlier when I said there is actually a big crossover here. It's a bit of a gray area. They can actually be the same thing. They can clearly be different as well, but there is a large crossover between them. So hopefully that helps you understand a little bit about what the difference between a concussion and a TBI is, what a mild, moderate, and severe traumatic brain injury are. And I started sneaking in some of the physiology about at least what's the symptoms. What are the behavioral and actual consequences? That is important to understand because now that'll tell us what we do in terms of a treatment or prevention strategy. In order to finally connect that dot, though, we got to walk through just a touch, and I promise this will be just a touch of the physiology or pathophysiology of each one of these categories, so we understand what we're trying to do with the nutrition or the micronutrient, why they solve those problems, and then ultimately how that translates into reduction or elimination of these symptoms.

Dr. Andy Galpin
So what's actually happening in the brain when we experience any of these three levels of a brain injury? There's a couple of resources I want to give you if you want to learn more about this right now. I based a lot of this episode heavily off of these papers, so I want to give them their due credit. They will, of course, be linked, and PDFs will be available in the show notes. You can find those at performpodcast.com. But for those of you who want to write it down right now, a paper that I found particularly helpful came out just last year in 2023, and that is titled "Optimization of Nutrition After Brain Injury: Mechanistic and Therapeutic Considerations." In addition to that, my friend and colleague Dan Garner has a product available for purchase on Amazon called "The Brain Synergy Protocol," and I will talk about that a little bit later. And then finally, I honestly took the vast majority of this episode off of a paper that I co-authored, and that's, depending on when you're listening to this, either in review or potentially published by now, called "Mitigating Traumatic Brain Injury: A Narrative Review of Supplementation and Dietary Protocols."

Dr. Andy Galpin
This was led by Tommy Wood, the fantastic neuroscientist at the University of Washington, and

was first authored by Federica Conti, another tremendous neuroscientist in her own right. So they did the bulk of the work here. We contributed on this paper together, and I thought it was honestly so perfect for a show that I thought, I'm just going to take this entire thing and make a whole episode out of it. But nonetheless, let's get into the paper right now. So what's actually happening in your brain when you experience an injury? Typically, we've been told that when you have some sort of injury, you have to go through this whiplash experience. So you have, say, a sudden stop. Your brain inside your skull continues to travel and then smashes up against your skull, and then therefore has a bruise on the brain. And while that certainly can happen, that's actually probably pretty unlikely. Generally, what's going to happen if that occurred is you would see the injury site being on the outside, right?

Dr. Andy Galpin
So you can imagine, let's just say the front of your brain smashes into the front of your skull. You would expect the injury to be right on the front, on the outside part of your brain. The reality of it is that's not where most concussions and TBIs occur. It generally happens more towards the middle of the brain. Remember, the outside of the brain is where your gray matter is. That's mostly where your neurons are. On the inside is the white matter. That's made of mostly fat, and it helps you conduct messages more quickly throughout the brain. See, what typically happens in brain injuries is you get more of what I call the accordion effect. And so you have so much fluid in your brain that if you were to slosh it around a little bit, there's not much room to slosh, and so it protects your brain from hitting the skull. But what can happen, though, is an intense pressure inside the tissue because it squeezes together and then gets expanded back out.

Dr. Andy Galpin
Picture the accordion here, me taking my two hands, putting them closer together, smashing it, pulling it back apart. And so you have this kind of egg-looking oval that is supposed to be your brain, and it gets smashed down into a vertical piece of paper and then extended way back out and stretched, and so on and so forth. So it's not the actual connection or contact to the skull that is always the issue. Sometimes it's that stretching and pulling and that pressure wave that causes the damage on the interior or various portions of the brain. And so the injuries are highly varied in the brain. It can be everything from a capillary or blood flow supply that is damaged or torn. The axon themselves can be torn. This then causes a host of issues that we'll get into step by step, but it's everything from temperature problems, energy problems, metabolism problems, inflammation, and physical structural damage.

Dr. Andy Galpin
So many different options that can occur, but that's basically what happens for most, but not all. This is obviously a complicated area. I don't mean to oversimplify it. Depending on if you had a single event, say a car crash or a single slip and fall, or numerous subconcussive events, think

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of blast injuries in folks in the military, small impacts with combat athletes or other people in professions that kind of bang their head a little bit, don't necessarily get huge symptoms, but they have a lot of these stack over time. All of it results in different problems. I'm just trying to highlight a small example of what it can look like as a quick overview. That being said, there are some generalities and commonalities between different forms of TBIs, and I'll just cover them broadly right now. The top of our list here is what's called comprised excitotoxicity. I'll explain what that means later, but this is arguably one of the bigger problems you will experience.

Dr. Andy Galpin
There are ionic disturbances, so your positive and negative charges get all messed up. There are blood flow to the brain, that's called cerebral blood flow, edemas and swellings, oxidative stress, inflammation, and then, as I mentioned before, even damage or even death in the cells that are directly in the brain or related to the brain. That can actually be going on acutely for weeks or even months to decades throughout life. So I can't go over all of this. It would take me the entire show, if not many. But I do want to cover a couple of very specific examples so you can start to grasp what this could look like. The first one is just if you've had capillaries burst. So remember, you have capillaries that surround all tissue in your body, and that's where all of your blood exchanges happen. So you have this network and this bed of capillaries that surround your brain. When those burst, you can't get nutrients and fuel in, and you can't get waste products out.

Dr. Andy Galpin
And so the most fundamental problem here is you don't get oxygen to the brain. So we lose cerebral blood flow, we lose energy production because we're not getting fuel in the brain because we've physically torn capillaries. If this was on your arm like it is on mine right now, you might have a purple and black arm. Thank you, Kam Haynes. But in your brain, you wouldn't see that. This goes right back to the invisible disease problem from earlier. More detailed example would be the following, though. Oftentimes, we'll break up TBIs into what we call the initial response and then the delayed or phase two response. So let's say you had some sort of direct hit. Again, pick your example. It might look something like this. Your initial response would be an overactivation of the neurons. That's right. The nerves that are associated with the injury area become overly activated. Now, this initial response is caused in large part by what's called overactivation of neighboring neurons.

Dr. Andy Galpin
So you remember all the nerves connected one to one to one. They're not actually physically connected. There's a small space in between them. And they communicate by releasing what's called neurotransmitters. So what happens in this area is you have a damage to one, it over-communicates to the next one, and you get way too much neuron activity. That's called

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overexcitation, okay, or excitotoxicity, because you're excited so much that it comes to the level of toxicity, and excited meaning the neurons being too active. Now, this happens in large part because of a molecule called glutamate. You'll see this all over the TBI literature, supplementation, marketing, very common to be talked about because it is very real and very important. It's the main neurotransmitter that's responsible for this excitatory activity, okay? Now, this gets released. In response to that, we have a whole downstream cascade of problems, and this starts off as an initial response, and then I'll show you how this turns into that delayed phase response later.

Dr. Andy Galpin
So we have this overexcitation. Now, if you go back to our episode on muscle, you'll learn more about how nerves and cells contract, why sodium and calcium and potassium and chloride are responsible for action potentials and so on and so forth. For now, sodium and calcium very specifically become overly activated. In fact, you literally oftentimes have damage to the plasma membrane. So the little thing that surrounds your cells gets damaged. It gets broken. And so because of that, the things that are supposed to be in the cell and things that are not supposed to come in the cell start leaking everywhere. So sodium and calcium start coming in and out of the cell in inappropriate manners. Now, this causes things that are eventually going to be cell death and degradation Because of production of what's called ROS. ROS is R-O-S, a reactive oxygen species. So remember, oxygen is very reactive.

Dr. Andy Galpin
It is good and bad. You have to have oxygen for fuel, allow you to create fuel, rather. It's a byproduct needed to make aerobic metabolism. At the same time, excessive amounts of it are going to be damaging. This is how we break down tissue. This is how we create and clean out dead and debride cells. And so if we're generating way too much of this reactive oxygen species, this is almost synonymous every time with oxidative stress. These are kind of similar terms. Not the exact same thing, but pretty close. This also activates several enzymes that damage the cell structure. These are everything from what we'll call proteases, so an ase is an enzyme that breaks down a protein, to lipases, these are enzymes that break down fats, nitric oxide synthases, and endonucleases, and other things like that. A whole cask of enzymes that start breaking the thing down. You don't know exactly what's happening here, but the cell thinks that there's problems, because there are, and so it just starts activating cell death.

Dr. Andy Galpin
So we're having issues with that. Okay? In addition to that, that calcium specificity becomes a problem because it alone harms mitochondrial health and efficiency. And so the cells that do stay alive start getting really damaged mitochondria. This is, again, because of a membrane damage issue that allows too much permeability of things in and out, and that, of course,

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eliminates or drastically reduces mitochondria's ability to work, which means your ability to make ATP. Remember, ATP is the cellular currency. It's the only way any living cell can create energy. And so mitochondria is not the only way we can make ATP. Hold onto that. We're going to come back to that. But it is a primary way, and it is the exclusive way in which we generate aerobic metabolism. So the way that we create fuel with oxygen has to go from mitochondria. So damaged or ineffective mitochondria is going to directly lead to reduced ATP production.

Dr. Andy Galpin
Reduced ATP production simply means we have way more cellular energy in our brain. This idea of brain fog or fatigue or can't remember things, recall executive decision, if you don't have energy, your brain can't think. That's quite literally what's happening. This is why some of the supplements and micronutrients we're going to talk about later have such positive effect, is they help you restore what's called that energy balance. The damage occurred. You weren't able to get transportation of oxygen and things in. This allowed permeability of calcium. This allowed too much excitation, which means we're burning too much energy. At the same time, we don't create enough energy, and so we end up being in this really catabolic or negative energy state, and now we can't think well, we're dealing with signs and symptoms, and overall, more importantly, our brain is actually physically unhealthy. And so because your brain is measuring energy production at all times, it knows this imbalance is occurring, it's going to try to alleviate it.

Dr. Andy Galpin
And the best way to do that is to ramp up energy production. But since it can't do it aerobically, it has to turn to anaerobic methods, and specifically what we're talking about here is anaerobic glycolysis. One more time, go back to our previous episode, I believe it was episode two on muscle, and we talk about the physiology and bioenergetics of how we use carbohydrates for fuel. It's the same. We're in the brain here. We're not in muscle, but anaerobic glycolysis is still anaerobic glycolysis. It's still the breakdown of carbohydrates for the production of ATP. So in this particular case, since the ability to store glucose in the brain is quite limited, and the amount that we can get into the brain through the blood-brain barrier is also somewhat limited, if we're only or mostly reliant upon anaerobic glycolysis, you can quickly see we're not going to be able to handle all the supply, because not only does the brain take an enormous amount of energy, it's in fact, depending on the situation, our most energy costly organ in the body, and now it's injured and it has more energy demands to recover and it has less energy production, we're going to be really running into problems with our energy deficit.

Dr. Andy Galpin
So to summarize all that, effectively what's happening here is you've got this disrupted cell homeostasis. This leads to all kinds of problems like cell death or apoptosis, DNA fragmentation, necrosis, cytoskeletal degradation, and a whole host of other things that are short and long-term.

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And that's just the phase one part. That's the initial response. From there, and once we've dealt with that, we now have to handle step two or the delayed or second phase, which is generally associated with neuroinflammation and prolonged oxidative stress. So what we're talking about here is this pervasive inflammatory cascade that is in combination with our metabolic changes, specifically to the blood-brain barrier. Now, remember, that's the thing that keeps things out of your brain and in your body and kind of keeps the separation there. If we've got a brain injury, we potentially have damage to that membrane as well.

Dr. Andy Galpin
And so we've got excessive inflammation happening, not even talking about the acute response. Now it's staying there and persisting for days, weeks, months, or potentially even longer. This causes migration of what's called peripheral immune cells into the brain and releases a whole storm of cytokines. These are communication tools that come out of your body from one organ to the next. They're not necessarily good or bad, but in this case, it's so large and it's so extreme that it continues to exacerbate this inflammatory problem. This also causes activation of things that are called residual neural cells. There's a whole host of these things like astrocytes, complement proteins, and so on. These things release reactive oxidative species, they release that glutamate again, and they release those cytokines. And so you can see how this circle just sort of perpetuates itself. It's not always a bad response, but in this particular case, since there's been so much structural damage One more time.

Dr. Andy Galpin
The cycle just continues. This is going to really harm the brain's healing. It's going to facilitate formation of what are called membrane attack complexes. You could just hear from that term, that's probably not a good thing. Again, we're trying to clean out the damage, but it's going to come with a lot of problems. This is going to create very specifically pores in the membranes of the target cells, which means those are going to often die. Now, in the case of a skeletal muscle from exercise, this is okay. It's pretty easy to repair. But when it's happening in your brain, it's a problem. So overall, we've got that oxidative stress response, and that's going to start damaging fat, protein, and DNA. Remember, big portion of your brain is made of fat. So while we're typically not concerned about oxidative stress harming all the fat in our rest of our body, that represents a serious damage to our brain and one that potentially is not reversible.

Dr. Andy Galpin
Now, I know I got pretty technical there, so if I lost any of you, don't worry about it. Just think about it this way. At the highest level, a TBI is going to involve some likelihood of a physical injury or damage. This could be your capillaries or any of your vessels, your blood-brain barrier, your membranes of your cells, your astrocytes, your neurons are actually physically torn. If you were a house, this would mean your windows are smashed, your door's broken, and you got a

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hole in the wall. It's not a functionality issue as it is an actual structure is broken and has to be repaired. Now, in addition to that, we're going to be dealing with a secondary problem, which is now because we don't have the physical structure to get in nutrients and get waste out, we can't make energy. So problem number two is a massive energy deficit. Your brain's going to try to get around it. It's going to start ramping up our less effective methods of producing energy, but it's never going to catch up.

Dr. Andy Galpin
And so physical damage, number one, energy deficit, number two. Number three, in response to number one and two, is this prolonged inflammatory response. And so we're sending in molecules that let the inflammation continue, and they exacerbate it, and they start breaking down and killing and getting rid of actual tissue. And so the ones that maybe were not injured initially will be injured or removed entirely in the weeks to months because of this inflammatory response. So effectively, those are our three big problems, which means now we can talk about what nutrition options we have to solve or mitigate or at least attenuate, slightly reduce some of those issues. I'd like to take a quick break and thank our sponsors. Today's episode is brought to you by Momentous. Momentous makes supplements of the absolute highest quality. For example, we've long known about the numerous health and performance benefits of fish oil.

Dr. Andy Galpin
I've personally been taking it for probably 15 years or more. Now, you can get fish oil anywhere, but personally, I only use Momentous because it's never once given me a fishy aftertaste, and more importantly, every single batch is NSF tested to ensure the lead and mercury levels are undetectable for purity and safety. Their fish oil is pure, potent, and sustainably sourced. Another major benefit is that you won't find any fillers in their fish oil. See, the dirty secret in the industry here is that most companies will add non-EPA and DHAs to their fish oil to keep their, quote, "fish oil count high," but to keep the active ingredients and therefore costs low. And it makes you actually feel like when you're purchasing it, you're getting more fish oil at a cheaper price, but you actually have to double or triple your dose to get the same amount of active ingredient, which means you end up spending more money in the long run, or you don't, and you get worse results.

Dr. Andy Galpin
If you want to give their fish oil a shot or any other Momentous product, go to livemomentous.com/perform to get 20% off your order. Again, that's livemomentous.com/perform to get 20% off. Today's episode is also brought to you by Maui Nui Venison. Maui Nui Venison is my absolute favorite thing to eat, period. It's beyond delicious and the highest protein per calorie meat you will find. Maui Nui Venison is 100% wild harvested meat, not fenced, farmed, or fed in any way and is far beyond the quality of any beef, grass-fed or

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whatever, you've ever tried in your life. And I know because I grew up in the country and I've tried it all. It's easy to cook and tastes incredible. My wife and small kids absolutely inhale it, and the jerky sticks are a daily staple for me with 10 grams of protein and just 55 calories. I literally ate two just now, and I send it to school with my kids all the time. While Maui Nui Venison offers the highest quality meat available, there is a catch.

Dr. Andy Galpin
Supplies are limited by nature. Responsible population management means they won't go beyond the harvest capacity. Memberships are the best way to ensure that you can get the meat you want whenever you want it, so be sure to secure your spot now. Visit mauinuivenison.com/perform for 20% off. Again, that's mauinuivenison.com/perform for 20% off. Let's jump right into it with our very first nutrient compound, and that's creatine monohydrate. You're probably sick of hearing me talk about it because I've been doing it for so many years, but it's for good reason. There's so much data on it. It is by far the most widely studied sports supplement, and it's not even close. It's been studied in every population, healthy, diseased, young, old, men, women, kids, so on and so forth, and there's really very limited side effects, if any, that have been reported. Now, creatine itself is a naturally occurring derivative of three very specific amino acids, methionine, glycine, and arginine.

Dr. Andy Galpin
These are really, really common. Creatine itself, I typically have talked about how it's stored in muscle and used as a great fuel source. But many people don't realize it's actually also stored in your liver, testes, and brain. The last one, of course, is where we're going to pay our attention to today. Now, it's stored in the brain so that it can be used as a very quick fuel source. Your gear should be turning at this point. Remember, one of the primary issues we have with the TBI is that energy demand problem. And so it made a ton of sense to scientists very early on to say, "Okay, we know that we have energy issues. We know that the fastest way any of our tissues can make energy is through creatine monohydrate, and we know it's in store in the brain already." It makes sense to try that to both prevent or reduce the risk of, and then treat brain injuries. So it's no surprise when we look at the research here on both TBI as well as aging and normal brain health research, to find that creatine monohydrate often improves cognitive function in both brain injury and normal, healthy aging folks.

Dr. Andy Galpin
Now, it's not the world's most powerful nootropic, but it is effective and been shown again in many models and many studies across many laboratories. So because it's so effective at giving energy, especially in low oxygen situations, you'll see evidence across injury and TBI papers, but also just normal cognitive function in healthy individuals to see benefit. So creatine is effective in all of those populations, and the physiology, biochemistry make total sense. Now, specifically

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regarding TBIs and concussions, one of the things you want to pay attention to a lot is what's called the second impact syndrome. Many people have not heard of this, but this is the basic idea of repeated head blows cause more damage as time goes on. And so one of the things that's been shown with creatine is it is really effective for that second impact syndrome. More specifically, it's been shown that the repeated head blows cause more damage if the creatine is depleted prior to the additional impacts.

Dr. Andy Galpin
Okay? So imagine you had one single impact. The more creatine depletion you have, the worse damage you get if you have a secondary impact. This is any athlete that's going to be in sparring or competitions where we're getting a lot of impacts. This is military or special forces or anything like that, that is, again, is getting low impact repeated exposures or blasts, okay? The more creatine depletion that happens, the worse the damage in your brain that occurs after the second or repeated impact. So right there, we can see that if you've had an injury, making sure your creatine stores are replenished as quickly as possible is really important if we're going to continue in that exposure. Now, that's important because many people don't recognize or realize the first injury happened to begin with. Okay? Most of them are unreported, most don't realize it, hard to diagnose. And so prophylactically, it just maybe makes some sense to make sure that you're taking care of business, not necessarily just when you have an injury, but if you even think you're at risk or in high-risk situations or prior to high-risk exposure or competitions.

Dr. Andy Galpin
Good example of this, there's a pretty famous study, I think it was in high school football players, high school or college, but nonetheless, football players, American football that is, that did indicate that creatine stores in their brain, and I think specifically in the motor and prefrontal cortex, reduced over the course of the season. Now, this is not a perfect study design, but you can see what this is alluding to. If you're in a situation, again, with repeated head impacts over the course of a season, the number of impacts-- So, in fact, maybe I'll back up quickly. In this particular study, what they did is they filmed the games. And so what they measured is for each individual player, how many head contacts they had. But there was an association between those players that had more head impacts, not even necessarily injuries, and the level of creatine reduction in the brain over the course of the season.

Dr. Andy Galpin
So again, we're making some assumptions here, but I think it's fair to at least say it's plausible the more impacts on your brain, the more creatine is reduced, potentially the higher risk you are for second impact syndrome injuries. Now, before we go any further with the creatine research, I need to do a quick pause and explain to you what I mean when I say strong evidence or weak evidence. There's no perfect way to do that, but an easy way to roughly understand is called the

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strength of evidence scale. Okay? So I will abbreviate that in the rest of today's episode by just calling it the SOE, the strength of evidence. Okay? This takes into account research design, the quality of the relevant studies, the applicability to patient care, and a number of other factors. It's up to you ultimately to decide what is an actionable level of evidence or not. Some people that are maybe suffering from a brain injury consider a study in animals to be enough, and others want to see a randomized control trial in humans.

Dr. Andy Galpin
That's not for me to decide, that's up to you. But I do want to share with you where the level of evidence is, and you can make your choice from there. So the SOE is on a scale of one to five. A score of one is the best. That is the highest score possible. This means we see consistent results across multiple studies. We've seen it in both randomized control trials as well as systematic reviews, and so on and so forth. A score of, say, four or five would be the opposite. That would be our lowest score. Maybe there's evidence there, but it's from case studies or case control studies. Maybe it's mechanism only or some other model that's close, maybe research from aging or dementia. Not the same as brain injury, but it shares some mechanisms. You get the idea here. So for example, the SOE for creatine monohydrate is a two. My opinion, personally, that's pretty good. Summarizing the collective evidence here, there's been a lot of research on everything from kids to rugby players to mountain bikers, and collectively, you're going to see it supports cognitive health.

Dr. Andy Galpin
It's been shown actually in psychiatric disorders. There's, I believe, two randomized control trials that I'm aware of that have found five grams of creatine per day, added in addition to antidepressant treatments, improve depressive symptoms. So take that for what you will. And regarding TBIs and brain injuries, there's an argument we can make here for preventative use, specifically for neuronal damage and injury. There's been shown to reduce cortical damage following a TBI by anywhere between 35% to 50%. That'd be five zero. Pretty substantial amount there. Should catch your attention. They don't know exactly how it works, but it's thought to prevent some of that mitochondrial dysfunction I was talking about a few minutes ago. It helps maintain the membrane health. Certainly has a role in fending off that downstream reactive oxygen species, ATP, calcium. So a lot of those things we just got done covering.

Dr. Andy Galpin
That's why we covered them. Creatine probably has a role. Again, we need more information here, but likely has a role in either eliminating or at least drastically reducing some of those issues. And finally then, what you care more about is the downstream TBI effects have also been documented. What I mean here is sleep, cognition, and actual mood seem to be enhanced with the creatine. Furthermore, there's actually some studies that have specifically been done on

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kids. There's one I'm thinking of in detail here that was everything from one to 18-year-olds that had severe TBIs. In this particular paper, they gave them 0.4 grams per kilogram of body weight. If you do the math there, that ends up being a pretty standard dose, but appropriately it was done based on body size. You have two-year-olds and 18-year-olds, we can't give them all just five grams. So a relative dose was given to them within four hours post-injury and done so for six months.

Dr. Andy Galpin
In that particular study, they found improvements in everything from amnesia to the length of stay in the ICU, improvements in communication, locomotion, and social skills. And more importantly, one of the things I loved most about this was the researchers were clear in the fact that the treatment provided costs significantly less than the standard treatment protocol. And this is something I felt was really important because I know supplements are not cheap, and many of you can't afford any cost whatsoever. But if you can, while creatine, I know, I know, I hear this all the time, has gotten more expensive in recent years, it's still likely far cheaper than a standard hospital protocol. So if you can possibly afford it, seems to be a pretty good option. Another thing I want to point out here, because it comes up all the time as well, in this study, again, remember, kids, six months of creatine, there were no signs of any kidney, liver, or heart side effects.

Dr. Andy Galpin
So overall, we would deem creatine as a pretty strong chance of success in both the physiology as well as actual symptoms, with a very low likelihood of injury or adverse effects. For me personally, I wouldn't hesitate to give this to one of my kids if they have it. It's entirely up to you to make your choice. I'm not advocating you do anything you don't want to do or are uncomfortable with. I'm just letting you know, for me, when I look at the research as a parent myself of two young kids, I would not hesitate at all to use this in my children. So how do you actually use creatine? Well, you have a couple of options. One, you can try to get this from whole foods, and I'll present to you exactly what that would mean in amounts. Or you can use the supplementation route. I guess a third option would be to use a combination of both. So most of the data on creatine monohydrate for brain injuries, they're typically using dosages of about 20 grams per day.

Dr. Andy Galpin
Now, that's four times the typical dose you'll see for performance benefits. So this is one of our major things we have to pay attention to. This is not a dosage that's just your standard five grams, five grams, five grams. It is much higher for the brain health benefits. Now, oftentimes, that's a little bit challenging, and so you'll see typical protocols, instead of taking 20 grams at once, are things like five grams administered four times per day. So the benefits are typically thought of as both acute and chronic. I know I've said many, many years now that creatine is not

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an acute thing. It's not caffeine. You don't take creatine right now and feel this big stimulation effects. It takes weeks or months to build up. However, one paper that came out recently kind of shook everyone's world, a 2024 paper. Again, just one paper here, so temper a little bit. I'm tempering my own expectations, but a recent paper suggested that a very high dose, I think it was 0.35 grams per kilogram of body weight, was enough to attenuate the drop in cognitive performance after sleep deprivation.

Dr. Andy Galpin
So you take people through sleep deprivation, the next day you give them this giant bolus of creatine, and those that took the creatine had less of a cognitive drop from sleep deprivation. I actually think the benefits started at about three and a half hours and lasted up to nine hours. So potentially, say something bad happened, and you didn't get a great night of sleep, and you could take this maybe 20-gram dose in the morning, and by noon or so, or for the rest of the day, you might have some improvements in cognitive function. That's the first paper I've ever seen that I'm aware of to show an acute effect of creatine. But since that was so dramatic, I wanted to make sure I drew it to your attention. So to me, you have an option there for brain health, and now if we consider this in context of the episode of today, even getting this creatine in immediately potentially has a brain impact, and that's why I wanted to bring that study up as it relates to the current topic.

Dr. Andy Galpin
Other studies have found that that 20 grams per day for seven days enhances cognitive function. This is specifically the mountain biker study I'm referring to. And so generally, me personally This is not the studies, this is me personally, based on the work that I've read. I think 5 to 10 grams per day is probably plenty for most people as a prophylactic. So kind of an ongoing option to be at that number. That said, and again, candidly, this is what I do for my athletes, seven days or so prior to a high-risk situation, a competition, something like that, a race or an event, we're going to up that dose to 20 to 30 grams for that seven days. All right? Again, one more time, when I do that, it is hard to choke down 20 grams at once. That's a handful of scoops. And so we'll often try to get 5 to 10 grams in the morning, 5 to 10 grams at night, and split up the dosages throughout the day, simply from a practical perspective.

Dr. Andy Galpin
Now, one of my favorite sayings is there are no free passes in physiology. Creatine is not perfect. It's not a panacea, and there are some potential risks. The biggest one is GI distress. Some people have gas or bloating or stomach cramps at even 5 grams a day. So taking them to 20 or 30 may cause some serious issues. It's not that frequently reported. I've never experienced it. I can't think of a situation where I've ever had an athlete or a client report it, but it is a real thing. It is pretty uncommon, but it is reported, and so you will want to pay attention to

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that. Outside of that, there isn't really any documented problems associated, even with high dosages, 20-plus grams a day, for years. There have been studies in kids, elderly, various we'll call risky or unhealthy populations for many, many years. You can look across basically all those studies, and you just won't find really any other adverse events outside of the possible mild or moderate GI distress.

Dr. Andy Galpin
Now, if the supplement does give you GI distress or you can't afford it, don't have access to it, or for any other reason just don't like supplements, you can theoretically get here with food, but it is admittedly very challenging, especially for those vegans and vegetarians, because the primary source of creatine from food comes from muscle or meat. The most common places of creatine in meat are going to be things like beef, chicken, salmon, tuna, cod, and they mostly have somewhere between 400 to 600 milligrams of creatine per 100 grams of meat. Now, I know in America, you're thinking, what the hell is 100 grams? The rest of the world knows exactly what that means. But 100 grams is about three and a half ounces. Okay? A typical serving size at a restaurant is seven ounces or so, and so you can kind of double it. In other words, beef specifically has 600 milligrams of creatine per 100 grams, but a typical serving is 200 grams, so you'd be getting 1,200 milligrams.

Dr. Andy Galpin
1,200 milligrams is also 1.2 grams. Okay? Now, the average American at least eats about 350 grams or 12 ounces of meat per day. So if you did some basic math there, which would mean you're at about 2,000 milligrams or two grams of creatine per day. So while it is possible theoretically to get all your creatine from food, it's honestly quite challenging, so supplementation just might be the better option in this case. I'd like to take a quick break and thank our sponsors. Today's episode is brought to you by AG1. AG1 is a foundational nutrition greens supplement. That means AG1 provides a variety of vitamins, minerals, probiotics, prebiotics, and adaptogens in an easy-to-drink greens powder. Initially, I was very skeptical of AG1, as I am with all supplement companies, frankly. But after months of discussions with their lead nutrition scientists and the team at AG1, I've been impressed by their commitment to sourcing the highest quality ingredients and rigorous testing to ensure that every single batch is free of banned substances, allergens, heavy metals, microbes, pesticides, herbicides, residual solvents, and mycotoxins.

Dr. Andy Galpin
It's even earned the prestigious NSF Certified for Sport third-party testing approval. Now, AG1 is not a replacement for eating whole foods, but it is a great way to fill in the gaps, and it's been a big help pushing some of my clients just in the right direction for eating more high-quality foods because it helps them with cravings, digestion, and many other benefits. Now, not everyone

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needs to consume greens powders, but if you're going to do so, you better make sure it actually includes the ingredients that it claims to and that those ingredients are of the best sourcing. If you'd like to try AG1, you can go to drinkag1.com/perform to receive five free travel packs plus a year's supply of vitamin D3 plus K2. Again, that's drinkag1.com/perform to receive five free travel packs plus a year's supply of vitamin D3 plus K2. Today's episode is also brought to us by David. David makes protein bars unlike anything I've ever encountered.

Dr. Andy Galpin
They have an amazing 28 grams of protein, only 150 calories, and zero grams of sugar. That's right, 28 grams of protein and 75% of its calories come from protein. This is 50% higher than the next closest protein bar. Honestly, it's the best-tasting protein bar I've ever had in my life by a mile. Now, I don't usually talk about products before their launch, but these bars by David represent a meaningful breakthrough in both macronutrients and taste. And when you guys try it, you will know what I mean. After lots of research and development, these David protein bars are releasing to the public in September of 2024. The macronutrients one more time are 28 grams of protein, 150 calories, and zero grams of sugar. And they do this with excellent ingredients. If you're interested in trying these bars for yourself, you can go to davidprotein.com/perform to purchase, if possible Or be notified when they're available.

Dr. Andy Galpin
Again, that's davidprotein.com/perform to purchase if possible or be notified when they are available. Our next topic is fish oil. More specifically, what I mean here is DHA and EPA. DHA is accumulated in the brain. In fact, it's about 10% of your brain or so. So makes a lot of sense that this one's going to be pretty important. It's critical for everything from neurological function to injury risk, metabolic rate, prevention of neurodegeneration, aging, and brain health, and Alzheimer's, dementia, so on and so forth. Incredibly important to actual structure. EPA is a little bit different. It's mainly involved in vascular function, inflammation, oxygen delivery, nutrient delivery to the brain, and so on and so forth. Right? So these are typically tied together, so I'm not going to really differentiate them, as most omega-3s come with both EPA and DHA. Now, while I said earlier that creatine is by far the most studied sports supplement, because it is, omega-3s are by far the most studied regarding traumatic brain injury.

Dr. Andy Galpin
There are dozens and dozens of studies, systematic reviews, randomized control trials on omega-3s and brain-related injuries and various head traumas. However, you might be surprised to know I'm not aware of any direct evidence of omega-3s and TBIs. So this is a great example of me saying, "Hey, look, there's still a lot of good tangential or indirect evidence here," so much I feel like it's overwhelming, but not necessarily that much directly on TBIs. For the reasons we described earlier, they're just hard studies to carry out. In general, what you're going to see is,

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frankly, they work. They work for both pre and post impacts. The SOE is technically three here, and you generally see main effects and benefits from cerebral perfusion, so this is getting that blood and oxygen and flow of nutrients in and out of the brain. Remember, the primary cause of injury there is that structural, that tissue and that axon shearing, that kind of ripping apart.

Dr. Andy Galpin
And so what that does is cause that cascade of secondary insults that mismatch the blood flow and the metabolic demand. We talked about that earlier. Omega-3s land right on that problem for solutions. And the reason is it helps dramatically with what's called arterial pliability and compliance. And so when we're having issues getting blood in, the arteries can either be broke or damaged or stiff, and omega-3s really help it become more pliable and open and close more effectively, is one way to think about it. It's also why you see so much evidence and research on omega-3s for heart health and blood pressure and so on and so forth. Has the same effect, essentially, in the brain. Other thing it does that's a huge benefit outside of that cerebral perfusion is it modulates inflammation post-injury by regulating that ROS, reactive oxygen species. It interacts with all kinds of cytokines like interleukin-1 and TNF alpha, if you're familiar with those.

Dr. Andy Galpin
If not, don't worry about it. Even, actually, there's one in particular called NF-KB. That brain folks will know exactly what I'm talking about here. This actually, functionally, it affects a gene expression of a bunch of inflammatory things, so it kind of cuts off inflammation at the genetic level. So lots of ways that it has an impact. To give you a couple specific examples, one of the most common issues associated with TBI long-term is called atrophy of the hippocampus. Now, that's associated in one of the areas that's mainly responsible for learning and memory, and we know that those are problems. Right? We know that higher omega-3 intake is associated with a bigger hippocampal volume. Right? So we have cross-sectional studies here, longitudinal ones that suggest again, people that consume more tend to have a larger hippocampus. And we also see a significant increase in these areas at the dosage of about 2.2 grams per day.

Dr. Andy Galpin
Okay? 2.2 grams of fish oil per day associated with a bigger hippocampus, therefore potential to improve or enhance our learning and memory. Similar things have been done with memory specifically. In fact, one study looked at, I think it was a combination of 900 milligrams of EPA plus 260 milligrams of DHA, and that resulted in greater accuracy and speed of recall tasks, so mental recall memory. EPA, in general, is often really associated with cognitive function, and the DHA is associated with axonal injuries. It works on a thing called neurofilament light, or NfL, and that's actually been specifically shown in college football players, I believe, again, at that two grams per day dosage of DHA. And so in general, to get to the end here, the dosage for

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brain-related injuries is somewhere between two to four grams per day, though there's really little risk. The only adverse issue you're going to typically have here is potentially some loose stool.

Dr. Andy Galpin
Again, there's not that much evidence of it, but if you consume a bunch of oil, that can kind of run through you a little bit. Probably not going to see much happen there very often. The timing of it doesn't matter that much. You would certainly want to be taking it before the injury as well as after the injury, and the timing of the day is honestly totally irrelevant. And so pretty easy, pretty fast one to go through, very effective. I personally, will be totally honest, I take a lot more than four grams for other benefits, but very fairly, the available evidence on not necessarily directly TBI RCTs, but the other associated areas of brain health and injury and damage, pretty consistently show the effect happens at about two or so grams, and studies that have looked at higher dosages don't see any additional benefit. So I think it's very fair to say two grams a day or so is the effective dose, and more than that may not give you additional benefit.

Dr. Andy Galpin
What's that look like from food? Another example where vegans and vegetarians really should honestly strongly consider Supplementation here. We're going to get fish oil from fish, pretty obviously, right? Salmon, herring, sardines, mackerels, trout are generally the most highest concentration ones. The salmon being the most obvious example. That's got about two grams of fish oil per 100 grams of cooked meat. Again, that'd be three and a half ounces or so, which is not an outrageous dosage at all. Unfortunately, the standard American diet is typically about 100 milligrams of omega-3s per day, and we need to get to two. So you're going to have to up your ante. It's totally possible, but most people just don't do enough of it. This is a really important one to go after. I know I just covered information, but I want to also highlight the fact that you can check. What I mean by that is, unlike creatine, where it's going to be really hard to measure your creatine monohydrate, especially in your brain levels, you, as a preventative strategy, should look at your omega-3 index and identify whether you have problems.

Dr. Andy Galpin
Because there's a lot of evidence to suggest if you go into a brain injury with a better omega-3, the brain injury will be less significant. So our starting place here is to actually not go into the injury with a problem. I mentioned this, but I'll be more clear. The omega-3 index is not a perfect way to measure it, but it is an effective blood test you can get done. And what that's going to effectively tell you is the percentage of EPA and DHA that's in the membrane of your red blood cells. And there's been a handful of studies on this that are quite impressive, in my opinion. Studies on football players and even basketball players have found that the vast majority of them have an omega-3 index of less than 5%. Optimal is like 8 to 10, maybe even 12. The overwhelming majority of these athletes are less than five. In fact, I think the studies I'm thinking

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of right now, the two kind of combined, basically none of the athletes had higher than 7%.

Dr. Andy Galpin
Again, 8 to 12 is what we're looking for. In fact, the reason we're doing that is because there's been known and shown documented cognitive benefits at 10% plus, even as low as 8% plus. So in these studies, no athletes are there. In fact, over 50% of the athletes in these studies had an omega-3 index of less than 4%. So it is really, really common in our athletes to see omega-3 status being really insufficient, and the same thing has happened in the general population. So you can 100% achieve enough for brain health through food if you'd like. You just need to make a concerted effort for it, and you can see, and you can go back to here the dosages, or you can use supplements or a combination, but you absolutely want to make sure that you're doing this prophylactically, as well as if you do experience an injury, getting right on the supplementation as quickly as you can. Next up is what's called vitamin B2 or riboflavin.

Dr. Andy Galpin
We're going into riboflavin next because it is a requirement for proper DHA utilization. Here's what I mean. There's some really nice studies showing that if you give people DHA, but they have insufficient B2, B6, B9, B12, and choline, they won't integrate that DHA into their brain. So it's really, really hard, technically, to get the DHA to integrate into the phospholipid membrane without these B vitamins. And so part and parcel to our appropriate omega-3 status is making sure we're not vitamin B deficient, and specifically in this case, we're talking about riboflavin. So it is a coenzyme for ATP production. It's a part of many of our energy production cycles. It's also highly responsible for glutathione. You'll hear me bring this up again, but glutathione is our chief endogenous antioxidant. It's the big whopper, okay? So going back to our problems associated with injury, riboflavin is going to play a role in two of those ones, energy production as well as inflammation or antioxidant capacity.

Dr. Andy Galpin
So really helpful from that regard. Since we know TBI has metabolic problems, it makes sense that these B2 and other B vitamins are going to probably play an important role. The SOE on riboflavin is a three. Now, personally, that's enough for me to take action. You're welcome to choose your own level of action on our score here, but I have utilized and will probably continue to utilize riboflavin for head-related injuries. There's great data in rat studies that have shown riboflavin helps with some of the behavioral modification issues associated with downstream TBI problems. Humans, there's not that much research, candidly. Again, that's why it has an SOE score of three, not two or one. And what we do know is there's kind of two studies in particular that are classic, and they both used about 400 milligrams per day. One of them is a bit older, 1998, I think it was published, and it was actually in migraines.

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Dr. Andy Galpin
And what it showed is that it was safe and well-tolerated. Now, interestingly, this was followed up in 2023, and they gave, again, 400 milligrams. I think they actually did it twice per day instead of once per day, starting 24 hours after injury. I think they had 50-plus people in the study, and they were all about 20 years old. Now, in that, they found a significant reduction in the number of days of recovery by about half. So the group that did not get the supplement, the typical recovery day was 22 days long. The supplement group, it was cut down to 10. So this was a very, very impressive result, and so it seems to be a somewhat high reward, low risk option. Additionally, the other B vitamins like B6 and B12 have probably more limited research, but they're really plausible. They're also really safe. They've been studied a lot in a lot of unhealthy or risky populations, and they just don't really have that many negative side effects.

Dr. Andy Galpin
So sounds logical to try these ones. There is a little bit of work here, particularly what I'm thinking of is some rat studies in cases of things like folate deficiency When that happens, a little bit of a background there, when you are deficient in folate, you have higher levels of what's called homocysteine. And homocysteine is highly associated with additional oxidative stress and a whole host of other negative health cascades. So really high homocysteine is bad news. Homocysteine is often also elevated when B vitamins are too low in general. That alone is associated with neuropathy of TBIs, brain atrophy, cognitive decline with aging, and so on and so forth. And so the clinical trials that have been done in this area, where they combine these B vitamins and omega-3s, have been shown to reduce homocysteine, and that has then also been associated with a reduction in cognitive decline. So if you can, pay attention to all those B vitamins, try to get them as high as reasonable, or at least not in those danger areas.

Dr. Andy Galpin
Take a look at homocysteine and pay attention to that. And if you do that, that will give those omega-3s a better chance to work more effectively, and you should be in a better spot. So what's riboflavin look like in terms of supplementation and food? One more time, the dosages that have been studied for migraines and headaches and brain health and things like that are 400 milligrams per day. One of the studies did that dosage once per day, another did it twice per day. But those are really, really common. Now, you can look all over the internet, and you will generally find every multivitamin has riboflavin, but it's not very much. So multivitamins are not going to be the place you can go to to get enough B2 for this issue. You're going to have to go to companies that make B2 specifically. In terms of timing, again, you want to take this after your brain injuries, certainly, but the better option is just to make sure your B status is high enough prior to going in.

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Dr. Andy Galpin
But if you didn't do that or don't know, you'd want to take this post-injury. Time of day doesn't matter at all. Some people will feel a little bit of an energetic effect, so perhaps earlier in the morning. Others don't, but you might want to consider that. I'm not aware of any risks associated with it. Obviously, everything has some risk at some dosage in some people, but for the most part, there's very little harm here. B vitamins typically don't have many issues if you over-consume them, outside of perhaps wasting your money, I guess, if you want to think about it that way, but there's really very little consequences at reasonable dosages, so you should be okay there. If you want to get this from whole food sources, this is where things like liver come in handy, or fortified cereals. Whey protein actually has a decent amount. Beef liver specifically has 3.4 milligrams of riboflavin per 100 grams.

Dr. Andy Galpin
Whey protein is about half that. I think it's about two, actually. So it's not a terrible source. So you can run the math very similar to how we just did it before. I won't drag you through it again. But if we have to eat something like 15 times-ish the amount of the serving size I just listed to get to that 400 milligrams per day, that's going to be a pound, a kilo, or a kilo and a half of beef liver per day. So again, theoretically possible, but just pretty unlikely or pretty unrealistic for most people to get these at this dosage through just food. Now remember, these are not daily amounts you have to take. We're talking about the dosages specifically for a brain injury, and so it's actually not that crazy to think you're taking it if you've experienced something like this. It's not something that you need to do every day your entire life. Next on our list is choline. Now, this has a handful of functions.

Dr. Andy Galpin
First, it's helpful in preserving that blood-brain barrier because it wards off membrane breakdown. It's critical to that cell membrane, so it has a handful of effects there. The second big thing it does is it is the primary precursor to the neurotransmitter acetylcholine. You may remember that acetylcholine is the primary neurotransmitter. That's the molecular signal that goes from one neuron to the next that activates it. We talked about this in a little more detail in a previous episode on muscle. So you can go back to that to learn more. But the third thing it does, it is a precursor to that important antioxidant glutathione. So a handful of functions here, both structural damage, cellular communication, and activation, as well as antioxidant. We also know from a lot of research in the area of brain aging, dementia, Alzheimer's, and so forth, that higher dietary intake of choline is strongly associated with decreases in several biomarkers that are associated with that Alzheimer's, dementia, and other risk factors.

Dr. Andy Galpin
So from a dietary perspective, from a molecular and mechanistic perspective, it's starting to line

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up as a pretty important molecule for both TBI as well as long-term brain health. To summarize the collective evidence, it is well-tolerated and safe. It's plausibly helpful, like I just described, and there's even some minor benefits in both physiological and cognitive domains following head trauma. The most common form of choline in the research is what's called acetylcholine or CDP-choline, as you'll see it sometimes, and it's been tested in multiple TBI randomized controlled trials. In fact, a recent meta-analysis indicated that there's about a 20% likelihood of success or effectiveness with acetylcholine for TBI treatment. So it's not perfect, but 20%'s pretty good in my opinion. Getting into the research just a little bit further, there's a handful of animal and human studies that are worth talking about at a very high level.

Dr. Andy Galpin
The animal research looked at 100 milligrams per kilogram of body weight per day, and I'm bringing up those numbers intentionally. I want to put some context behind that, honestly, because I've just heard people misinterpret this paper a lot. So 100 milligrams per kilogram per day immediately after an injury, which resulted in significant improvements in what's called spatial memory performance. Now, you can't simply equate body weight here to humans. You'll get an absurd number that won't make sense. It doesn't actually work that way for details we don't want to talk about now. But what this would equate to is something like 60 to 70 milligrams per kilogram in humans, and that is high. It's about three to five times the dosages used in human research, but it's not impossible either. So I do want to acknowledge that those numbers are, again, high, but it's not completely crazy either. In fact, some of the studies at 250 milligrams helped with the blood-brain barrier breakdown, and edema were largely reduced in those trials and also had benefits in hippocampal neuronal death for the seven days following injury.

Dr. Andy Galpin
So pretty good mechanisms from the rat studies. In terms of the human, you will see that the studies are mixed. One gram per day for 30 days has been found to, in at least mild TBI, to produce statistically significant improvements in recognition memory, which is obviously an important downstream behavioral problem that's associated with TBIs. And that study was actually repeated about 20 years after the initial one, and they used a pretty similar protocol design and found actually no difference in TBI symptoms. I think it was headaches, sleepiness, dizziness, and concentration, and things like that. However, what's really important to note here is, in this study, the majority of the participants had really minor TBIs, meaning their cholinergic pathways were probably not affected. This is a classic case of something I warned out the beginning or earlier in our conversation. If you're not actually giving a supplement or taking a food that the mechanism of effect is not the mechanism of injury, well, then you shouldn't expect a benefit.

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Dr. Andy Galpin
So I think this is really a case of that. I actually do feel like the strength of the evidence for choline is okay and reasonable, but that 2023 follow-up study, to me, is not an indication that the original study was flawed or didn't work, but simply you had mild injuries that didn't result in damage to that pathway, so the supplement provided very limited or mixed benefits. In addition, I know of two meta-analyses that reported generally positive benefits here, regardless of TBI severity, so that's some more information of positive benefit. And the probably landmark study in this area came out fairly recently. It was called the CoBRIT study. I think it stands for Citicoline Brain Injury Treatment Trial. You know how scientists always like to make these acronyms for our big studies. Again, honestly, I feel like this is being misinterpreted, in my opinion, and so I want to touch on this just really briefly.

Dr. Andy Galpin
But in that, they found no evidence of benefit for cognitive function or cognitive status 90 days post-injury with two grams a day of citicoline. Now, a lot of people have used that to say, "We told you. It doesn't work." And that's fine. People can interpret how they will. My personal opinion on this study, though, is that it's highly flawed, and I'm saying that because in it, they considered adherence to be 75%, meaning if the people in the study took their citicoline 75% of the time, they were considered to be adherent. Only 44% of their participants met that 75% mark. 40% were considered to be non-adherent, so that means they took it less than 75%, and the rest, they don't even know. So for me, it's hard to suggest that it didn't work when the vast majority of people didn't actually take it most of the time, and those that did was still only 75% of the time. So cool study, helped add a lot of information, in my opinion, to the database, but I don't think it should be interpreted as saying that choline then therefore doesn't work or it's a myth or any of those other more extreme interpretations of these data.

Dr. Andy Galpin
More directly for the context of our show today, been done on football players where brain choline, specifically in the primary motor cortex, is known to diminish across a season, similar to what we saw earlier with creatine. Probably as a result of those continuous head impacts, though it couldn't be inferred directly from this study, but pretty easy to make a guess that's a likely scenario. And this actually may contribute to that second impact syndrome and accumulation of damage. So similar idea here as creatine. To me, pretty strong case. So based on the different study designs, mixed results, and other limitations, the SOE for choline lands at a three. So what are we looking at in terms of food and supplements? Well, first of all, you're not going to find choline supplements on their own very commonly. It's almost always going to be in the form of what's called alpha-GPC, or in the more direct version of phosphatidylcholine.

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Dr. Andy Galpin
Now, alpha-GPC is immediately metabolized into phosphatidylcholine, or PC, once you orally ingest it. So you can think of these as similar products. Many companies make either PC straight or alpha-GPC or have a little bit built into oftentimes B complexes. Dosages are usually a little bit lower, 20 to 30 milligrams. If you're getting the alpha-GPC directly, Momentous, of course, the sponsor for the show, as well as other companies, generally will make dosages 300 to 400 milligrams per serving. So you'd need to take three or so of those to get to this dosage level. But you will find that fairly commonly. Now, in terms of timing, you probably want to take something like 500 milligrams per day as a daily dosage prophylactically. However, if you've had a direct head injury, this might be the time to ramp up to one to two grams. These generally do have a nootropic effect, and so you would want to take these earlier in the day, so you certainly don't have any problems cognitively or with sleep later on.

Dr. Andy Galpin
In terms of food If you need to get up to that one to two grams after an acute injury, you're probably going to want to use supplementation, but it's quite easy to get to that 500, that baseline prophylactic dosage straight out of food. A couple of eggs and some turkey will almost always get you right there. The most common places to get choline in food are meat, poultry, fish, eggs, dairy, beans, cruciferous vegetables. Beef liver, for example, has around 400 milligrams per 100 grams of liver. Eggs, it's about 150 milligrams per egg. And so you can actually see, all right, three or four eggs in a day gets you really close to that 500 number. Most people, a couple of eggs, a little bit of serving meat, you're going to be right there throughout the day, which again, will put you in a pretty good spot. The average person, though, doesn't get enough choline. Typical numbers in men is around 400 milligrams.

Dr. Andy Galpin
Women, it's about 300 or so, which is well below the AI, or adequate intake, which is 550 for men and 420 or so for women. So you would have to probably do something in the neighborhood of 12 eggs to get you to that two grams of choline per day. So like I said, totally fine to get this from food as your normal baseline health strategy, but if you did want to get those upper dosage with an acute injury, you're probably going to have an easier time getting a little bit of supplementation rather than trying to eat 14 or 15 eggs in a day. All right. Moving on to our next one. We're looking at branched-chain amino acids. To clarify, when I say BCAAs, I'm almost always talking about three amino acids in particular, isoleucine, leucine, and valine. Now, leucine is the primary driver of muscle growth or muscle protein synthesis, which is why there's so much steam behind BCAAs for muscle growth. We'll talk about those details later, but in general, if you get enough protein, BCAAs are not really needed for muscle growth.

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Dr. Andy Galpin
That said, does something different in the brain. The human data do suggest that the severity of your TBI symptoms correlate well with the degree of BCAA suppression in the brain. Bigger drop in BCAAs, more symptoms. The BCAAs have two big effects. One of them is the fact that they are what's called a nitrogen donor, and the other is that they help transportation interference across the blood-brain barrier. So let me walk you through what those mean really quickly, as it's important to understand why they actually work in this case, but perhaps are not so important for muscle growth. Now, when I say nitrogen donor, what I mean is they are specifically used as in broken down to give off nitrogen, which can be used for glutamate and GABA. I already talked about glutamate earlier and how that is a primary problem with extreme excitotoxicity, so getting too excited, turning too many neurons on.

Dr. Andy Galpin
Now, both GABA and glutamate are heavily involved in TBI pathology, like we just talked about. From the transporter perspective, when you eat protein, the amount, or this is food or a supplement, the amount of BCAAs in your blood goes up. Makes sense. Put a bunch of proteins in your stomach, they get broken down into amino acids, amino acids in your blood go up. If you ate a complete protein, that will come with a bunch of BCAAs, the amount of those go up in your blood. Now, as the BCAA concentration goes up, two molecules called tryptophan and tyrosine, they happen to share the same transporters to get through the blood-brain barrier. So if you have this big rise in BCAAs in your blood, the BCAAs will block up those transporters, which means the uptake of tyrosine and tryptophan are blocked. So they're not going to get across the blood-brain barrier, not going to get in the brain. Okay? So the amount actually in your brain of T and T, tyrosine and tryptophan, go down.

Dr. Andy Galpin
What that does is cause problems with things like serotonin, because T and T act as precursors for serotonin, which, of course, is in a precursor for melatonin and various catecholamines. Right? So this could be contributing to the TBI-induced sleep problems. And so you can see the basic logic there. The current evidence does suggest that actually sleep is not compromised with BCAAs, but actually even potentially improved. I know of actually a study coming to mind right now that looked at 30 grams of BCAAs administered twice per day, found it actually improved insomnia and other latency-related issues. This was a study, I think it was in veterans with chronic TBI. And so we know some about the mechanisms that I just outlined, has the potential to be influencing some of our sleep-related problems, and it seems to be causing a positive and beneficial effect for sleep, which is a huge concern and one of the biggest symptoms associated with the brain injury.

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Dr. Andy Galpin
The SOE on BCAAs is surprisingly a two. Remember, one is best, five is worst on this scoring. So the data are actually pretty strong here. It is pretty clear that it works as much as we can define work. There is extensive evidence in post-impact for both mild and severe TBIs. The benefits range from cognitive deficits, so reductions in cognitive deficits, to what I just described, some of these sleep-wake abnormalities, with the main effects probably being correction of that excitotoxicity issue, and some of the GABA and other glutamate problems that we have just described. Probably the most famous study in this area is called the HIT-HEADS trial. I believe this came out in 2024, actually, so pretty recent. It was a pilot randomized controlled trial. They had, I think, 10 to 35-year-olds in there, so teens, preteens, all the way up to normal age. And they followed them for three weeks or 21 days post-injury, and this was really cool.

Dr. Andy Galpin
They had, I think, five arms in this study. So some of the participants just got a placebo, and then they broke up the rest of the intervention by dosage. So they got 15 grams a day, 30 grams, 45, or even 54. I'm not sure why it wasn't 55. But they wanted to see, is there an effect at all compared to placebo? And if there is, what's the optimal dosage? And they gave them five different dosages, from low dose to more moderate to pretty high, and scaled all the way up. And one of the things that they found was a pretty clear dose response, such that the most improvements were found in that 54 grams per day, decreased symptoms of concussions, faster and better return to baseline. There were not benefits, actually, in what was called processing speed. So that had been shown in some of the earlier studies we talked about, but they didn't find that here for whatever reason. But they had all those other benefits.

Dr. Andy Galpin
One more time, highlights the fact that not every supplement, not every food, not every nutrient fixes every problem. Okay? So benefits here in the concussion symptoms, but not necessarily the processing speed. But the effects, one more time, were dose-dependent, and one more time, like we keep bringing up, there was no adverse effects reported. The data that we currently have suggests up to 55 or 54 grams per day, more specifically, is the dosage. You would want to make sure you're at that higher dosage past injury. You can be at a much smaller one, just honestly make sure your protein intake is high enough. You can use whatever number you like. We've talked many times, though. I personally like one gram of protein per pound of body weight. If you're at that, you're probably getting enough BCAAs at baseline, and then we would go to only this higher dose post-brain injury. To break this down food-wise, BCAAs, it's protein.

Dr. Andy Galpin
It's dairy products. It's meat and poultry. Most meat's going to be three to four grams of BCAAs per 100 grams of serving. And so similar math that we've done before. Okay? This is going to

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result in you having to have 40 or 50 ounces of meat per day.

Dr. Andy Galpin
Not something you need baseline, but in these small cases, again, I don't want you to feel like I'm pushing you to supplements, but it is just significantly easier here for small times and for specific scenarios of a brain injury to go to supplementation here. Our next micronutrient is magnesium. Oh my goodness, could I go on and on and on about the physiological benefits of magnesium. It is involved in well over 600 reactions in your body, from cell signaling, vascular function, ATP production, protein synthesis, neuroplasticity, learning, memory, and I could basically think of anything that happens in your body, and magnesium's central to that. I don't have to draw this out then. It's pretty easy for you to assume this is going to be an important role in your brain pre- and post-injury. We also have very strong data if you are deficient in magnesium. You have associations with a host of comorbidities, health conditions, type two diabetes, metabolic syndrome, hypertension, headaches is another common one, migraines, heart disease, so on and so forth.

Dr. Andy Galpin
We know that it probably inhibits receptors that are directly targets of antidepressants as well, and is a strong contributor to that brain excitotoxicity after injury. So you do not want to be deficient in magnesium. You can listen to, read almost anything in the sports performance realm, and you will see magnesium as a top-tier supplementation. It is really robust and a strong line of evidence and recommended by, again, many people in this field. But surprisingly, the SOE is only three here. There's a well-documented drop in magnesium, especially in your central neurons, after a TBI, and the extent of that drop is associated with the severity of the injury and the level of behavioral disturbances. So not only the injury, but your symptoms as well. Animal and human research here from the animals, it's associated with edema, brain and blood concentrations, calcium problems like we talked about earlier.

Dr. Andy Galpin
These are going to result in those behavioral modifications, memory, cognitive function, spatial and working memory, and so on and so forth. From the actual human stuff, a couple of studies that are worth drawing attention to here. One looked at acute TBIs in kids and saw a significant reduction in post-concussion severity scores 48 hours after the injury when they used 400 milligrams of magnesium twice per day. Now, another study used a similar design and didn't find a benefit, but this was actually using magnesium from an IV for five days. Now, no one really actually knows why this one trial worked and the other one didn't. The obvious thought is maybe there's something that happens when you ingest it through your stomach that aids in digestion or makes it more bioavailable, but when you took it with the IV, it didn't. To me, that's honestly not a great answer, but I don't have any other reason to think that that happened.

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Dr. Andy Galpin
So really honestly, to summarize here, it is very, very safe. It's very little harm. It has so many other health and performance-related benefits. There's so many health consequences that are associated with magnesium deficiency. It helps with symptoms and behaviors that are hallmarks of TBI like we've talked about. So I know the SOE is technically three, but personally, it's about as high on the list as I could think one supplement could be. The dosages we described, one more time, 400 milligrams per day. The timing doesn't matter. You'll want to have some in there pre- as well as post-injury, and you could take it at any point in the day. Now depending on the type or form that you use, you might want to take it later in the evening. Some people report, and depending on the type, magnesium helps you fall asleep. I personally feel no effect at all, but most people do. I still then take my magnesium at night just because, just in case.

Dr. Andy Galpin
There's all kinds of forms. You've heard of magnesium threonate at this point, bisglycinate, malate, and right now, I don't know of any compelling evidence to suggest one of those forms is any better than another. Obviously, magnesium threonate has become more popular recently, and that may turn out to be more effective. It may not. I'm not sure. There's just not enough data for us to have really an answer at this point. And so you can take whatever form sits best with you. The obvious risks associated with magnesium are the GI distress. Bisglycinate, malate, threonate are generally pretty well-handled, and so you shouldn't have too many issues with it. If you want to get it strictly from food, you're looking now at things like pumpkin seeds, chia seeds, almonds, and spinach. Typically, I think pumpkin seeds are about the highest you'll find. They've got around 200 milligrams of magnesium per 100 grams roasted.

Dr. Andy Galpin
And again, you can do some math there and realize, all right, that's at least 200 grams of roasted pumpkin seeds I'd have to get to get to my 400 milligrams, which is honestly quite a lot. Not impossible. Some people eat tons of almonds and spinach and things like that, especially vegetarians and vegans, but it is quite a bit. Given how cheap, effective, and easy to handle, and how many other things are benefited with magnesium as a supplement, we use it pretty commonly. Our final food item to discuss is what's called anthocyanins. Now, these come almost always from blueberries, so henceforward I'll call these blueberry anthos. That's how I refer to it. Now, these are phytochemicals in the flavonoid family. There's over 700 known antho molecules, and we're honestly basically just learning about this stuff. So we have a ton of improvements needed, a ton more analysis and understanding of mechanisms and so on and so forth, but there's enough here to go on at this point.

Dr. Andy Galpin
We know that anthos are involved in cardiovascular disease, metabolic syndrome, type 2

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diabetes, cancers, vision, skin health, inflammation, neurodegenerative disorders, and probably 50 more things. Really ubiquitous, really robust, and critical to a bunch of human functions. TBI specifically, animal research here, blueberry supplements or blueberry extracts post-injury have been shown to improve what's called brain-derived neurotropic factor, or what you may have heard of as BDNF, which is inversely correlated with indirect markers of memory, performance, and cognition. Now, a similar study has found that blueberries also protect against oxidative stress, which makes a ton of sense. You've all probably heard about the antioxidant properties associated with blueberries and blueberry extracts. So this is no surprise for most people. The SOE for anthos is a three, and in terms of human data, I don't think there's a single RCT, randomized control trial, that exists for blueberries and TBI at this point.

Dr. Andy Galpin
That said, there have been studies, many RCTs, some in fact that range from developmental to aging to clinical populations, on brain health. And so this is a classic example of where we can infer some things from general brain health over to TBI at a pretty low risk, high reward possibility. The collective evidence indicates that it does help with attention, memory, executive function. There's a lot of evidence. Specifically, we use a handful of papers that have been done looking at blueberries prior to golf and enhancing brain performance in sport context. So there's a lot out there. We know it works, but we also know we're missing a lot of the details because of what I just described earlier. It's pretty new. A couple of examples. One study in kids in particular looked at 15 or 30 grams of freeze-dried wild blueberries and saw significant improvements in cognitive function in a dose-dependent fashion.

Dr. Andy Galpin
More blueberries, the better. Other work has been done in older adults looking at things like 100 milligrams blueberry extracts and seeing better episodic memory performance, reduced cardiovascular disease, and so on and so forth. So, what this would look like from a whole food source, to get something like 500 milligrams of anthos, you'd need 100 grams of blueberries, which is, I think a cup has 150. So I'll translate that for you a little bit. You have a cup of blueberries, and you'll probably hit your numbers. It's really that easy. I would actually say that of all the things we've discussed so far today, this is the easiest one to get out of straight food. You will be hard-pressed to find a program that ever comes out of myself, our Rapid Health and Performance company, or any other one that I'm associated with that doesn't have a cup of blueberries in it, and it's for these reasons and many more.

Dr. Andy Galpin
So it's a pretty easy number to hit, pretty consistent, and has a lot of benefits, right? I will also tell you, people love to give blueberry all the credit here, but it's not the only food item that's got the anthos in it. Strawberries, cranberries, they have it too. There's not as much data. I don't

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actually know if there's any data, but I imagine if they did those studies, you'd probably find the same benefits. So I'm actually not as particular on this one. I don't have evidence to support myself, but I don't think it's that big of a stretch to think the same chemicals, in this case that are in blueberries, probably also exist in raspberries and strawberries and other similar forms. So, we will spread our berries out, but if you want to stick to giving all the love to blueberries, you're not going to hurt my feelings. As far as I understand it, that represents all the evidence on food-related items one can take for brain health, TBIs, and concussions.

Dr. Andy Galpin
The only thing I'm aware of that's actually detrimental for brain healing is caffeine, and there's enough evidence here that this is probably pretty bad news when trying to heal from a brain injury. It causes neurovascular constriction. It leads to less blood flow. We know that caffeine consumers are more susceptible to diminished emotional health, bad sleep quality, depression, and somatic symptoms with brain injuries. And so what my recommendation here would be, overconsumption is the problem. Do not overconsume caffeine if you've experienced a brain injury. I don't think there's any reason to think caffeine consumption is going to give you more risk to have a brain injury, but if you have one, you want to make sure you're really careful. Ask your doctor, check in there, but that's the only one on our list that we have reason to think that you should avoid. That concludes today's episode on nutrition for brain injury, TBIs, and concussion.

Dr. Andy Galpin
I think it's worth reminding you, though, that if it's good for preventing and returning faster from a brain injury, it's probably safe to assume it's also good for brain performance as well as long-term health. My goal of today, as always, was to provide you with a ton of information so that you can be excited, you can learn, you have some things to try, but to also be fair with the state of the data, and you can make your decision about what you want to do or not do based upon that. Given this was episode 10, not only are we done with today's discussion, but we are done with Season 1 of Perform with Dr. Andy Galpin. I can't thank you all for the support. I seriously was overwhelmed with comments from people I know, don't know. It blew past my expectations, and so I really just cannot thank you all enough. If you're a new listener, and this is maybe your first episode, you can go back and check out all previous nine episodes on performpodcast.com.

Dr. Andy Galpin
You can check out the notes. You can go to YouTube, and you can see the exact sections of a particular video if you're interested in that. And we've made it as easy as possible, hopefully, for you to go straight to the information you're looking for and not spend time on things you are not. I can also share with you another fun announcement, and that is that Season 2 has officially been

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confirmed. It's going to be coming out pretty soon. If you want to know more about when that does hit the radio waves, you can stay tuned, of course, on my social media. But also, I would recommend signing up for our newsletter. Finishing us off here, I cannot conclude this season without some very specific thank yous. First of all, to all the sponsors, it was overwhelming your support. The people jumped on board quickly and were really, really helpful. So this show would not have existed without them. So I know ad reads are a thing, but please do me a solid.

Dr. Andy Galpin
If you enjoyed any part of any of the episodes of this season, go check out the sponsors. They really are phenomenal products. I got to thank my special man, Vin Dog. You know who you are. Helped me a ton in preparing for this. He's not the front-of-the-camera kind of guy, so appreciate it, Vince. Natasha, of course, my wife, super, super supportive in all the time it spent to come up here and get this stuff done. My students, former and past and current, could not have done any of the stuff that allowed me to be up here without all of your support and truly doing all the work in the lab. Same thing for all of my colleagues and fellow scientists whom helped me directly with this show or indirectly, and that I stole your research or read it at least and was able to have information to share with people. So science is not easy, and a lot of times people don't get the credit for it, and I thank you all for your contribution.

Dr. Andy Galpin
All of my teammates and colleagues at my companies, Rapid Health & Performance, Biomolecular Athlete, Absolute Rest, and Vitality. Again, tons and tons of support for everyone, so I appreciate that. And then finally, of course, my man here, my boys here at Scicom, and of course, Dr. Andrew Huberman, love you all. Super appreciative of it. Thank you all so much for joining on this ride, and I'll see you next season. Thank you for joining for today's episode. Our goal is to share exciting scientific insight that helps you perform at your absolute best. If the show resonates with you and you want to help ensure this information remains free and accessible to anyone in the world, there are a few ways that you can support. First, you can subscribe to the show on YouTube, Spotify, and Apple. And on Apple and Spotify, you can leave up to a five-star review. Given that we're a new podcast, subscribing and leaving a review really does help us a lot.

Dr. Andy Galpin
Second, please check out our sponsors. The show would not exist without them, and they really are exceptional products and services. And then finally, you can share today's episode with a friend who you think would enjoy it. If you have any content, questions, or suggestions, please put those in the comments section on YouTube. I really do try to read these and see what you have to say. If you have yet to sign up for our monthly newsletter, you can do so at performpodcast.com. Our newsletter provides episode summaries with the key takeaways for

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Dr. Andy Galpin

I use my Instagram and Twitter also exclusively for scientific communication, so those are great places to follow along for more learning. My handle is DrAndyGalpin on both platforms. Thank you for listening, and never forget, in the famous words of Bill Bowerman, "If you have a body, you're an athlete."

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