

Enhancing Bone Health at Every Age

Perform with Dr. Andy Galpin · Episode 14 · February 26, 2025 · Transcript

This transcript was generated using speech recognition software and may contain errors. Please review the episode audio before quoting from it.

Dr. Andy Galpin

The science and practice of enhancing human performance for sport, play, and life. Welcome to Perform.

Dr. Andy Galpin

I'm Dr. Andy Galpin. I'm a professor and scientist and the executive director of the Human Performance Center at Parker University. Today, we're going to be talking about bone health, and I wanted to cover this for many reasons, but first and foremost is the fact that 50% of people out there at some point in their life will break a bone. And so we want to do our best to minimize that chance, that likelihood of us breaking our own bone. But then on top of that, somewhere between 5% and 10% of broken bones will not heal correctly. So after something has happened, we want to make sure that we're not in that 10% of people so that our bones heal correctly and as quickly as possible. Obviously, the more common and more frequent it is for us to break bones, the worse our health is going to be. Having them not heal correctly is going to lead to a whole host of other short and long-term health problems.

Dr. Andy Galpin

All right, so why do you care about this? Well, people tend to think about bone health and their mind, at least mine did initially, jumps to things like, well, this is only an issue for older people, and then really this is an issue for older women for reasons I'll discuss here shortly. But that's not necessarily the full story here. There are special things we need to pay attention to, especially for post-menopausal women. But the reality of it is the prevalence of poor bone health is extraordinarily high across the globe in men and women, and it's rising at a rapid rate. There's some data that came out recently suggesting that in 2007, the prevalence of poor bone health here at least in America was around 9%, and that has risen to close to 13%, again, in the last decade alone. On top of all that is the fact that it is what we call a silent disease. So it is unlike things like obesity or metabolic issues, brain health, mental health, where you won't necessarily know what's happening.

Dr. Andy Galpin

So part of the reason why bone health is so poor in so many people is because people have no idea. There are no signs. There are no symptoms. You don't feel it. You don't see it. You don't hear it until the bone breaks. So it's really common, it's increasing, and you probably don't have

any idea that it's happening. On top of all that, it is extraordinarily preventable. So somewhere between 20% to 40% of your bone health is determined by your lifestyle. There are, of course, genetic components filling in the rest of the gap there, but you have a huge say, and the say is distributed across lots of different options. So that's the foundation of what we're going to cover today, and let's jump right into it. Today's episode is sponsored by LMNT. LMNT is an electrolyte drink mix that has an ideal electrolyte ratio of sodium, potassium, and magnesium, but no sugar. Hydration is critical to performance, both physical and mental performance.

Dr. Andy Galpin

Countless studies have shown that even a slight degree of dehydration, even as small as 1%, can lead to decreases in physical output and mental performance. We also know that electrolytes are critical to proper hydration, which I've been harping on for years. But you can't do that proper hydration by only drinking water. You need to get the right amount of electrolytes in the right ratios, and that's why I'm a huge fan of LMNT. In fact, many of you will probably remember that I featured LMNT in my YouTube series on optimizing hydration nearly five years ago. I featured LMNT in these videos because their blend of 1,000 milligrams of sodium, 200 milligrams potassium, and 60 milligrams of magnesium really is unique and different than any other electrolyte on the market, and it has great scientific support. I use LMNT constantly, particularly when I'm sweating a lot, and I routinely make it a part of my clients' optimization programs.

Dr. Andy Galpin

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 sponsored by David. David makes protein bars unlike any I have ever encountered. 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 that protein. This is 50% higher than the next closest protein bar. Honestly, it's the best-tasting protein bar I've had by a mile. While I often talk about the importance of getting one gram of protein per pound of body weight for things like muscle health and recovery and the promotion of lean body mass and satiety, the reality is that for most people, getting that one gram of protein per pound of body weight is really challenging. However, David makes that easy.

Dr. Andy Galpin

Their bars taste incredible and are each packed with 28 grams of protein. I eat one almost every day and always have two or three in my backpack when I'm traveling. Like literally always. It probably sounds funny, but I eat them as dessert all the time. When you try them, you'll know exactly what I mean. The macronutrients, one more time, are 28 grams of protein, 150 calories, and zero grams of sugar. If you're interested in trying these bars for yourself, you can go to

davidprotein.com/perform. Again, that's davidprotein.com/perform. The first place I want to start is basic terminology. What you'll hear in this field is three basic things: osteoporosis, osteopenia, and then collectively poor bone health. And so very first, the way that you want to think about this is it's akin to something like diabetes, where you have pre-diabetes, and you have full diabetes, and diabetes would be collectively put together as something like poor metabolic health.

Dr. Andy Galpin

And that's essentially what we're looking at. So osteopenia is this very first stop on the journey to poor bone health. Osteoporosis is now that full clinical disease Which they both have technical definitions. Officially, osteopenia is one standard deviation below the norm. Osteoporosis is two and a half standard deviations. But the point is we're trying to look at bone health as a progression and saying, "Hey, we know that if you get to technically osteoporosis, your prevalence and likelihood of breaking a bone jumps astronomically, and that then leads to shorter lifespan, more suffering, and so on and so forth. So let's stop this problem before it happens, and so we can identify people that are clearly along the path of low bone quality, and we'll call that osteopenia." You smash those things together, and we now collectively call it poor bone health. Globally, something like 40% of the population is in osteopenia.

Dr. Andy Galpin

Let that thing sink in. 40% of our population probably has suboptimal bone health. 20% probably officially qualifies as osteoporosis. Now, in those over 50, over 20% of women have poor bone health. So if you're listening right now and you're a female, or you send this to a friend of yours who's a female and 50 years old or older, there's a 20% chance you're actually already in osteoporosis. Good news is, and we'll talk about this shortly, this can be improved. We can go backwards here. It is something we can potentially reverse, but it is really, really common. What I want to focus on today is what do we do about it. We will, of course, cover the three I's that we are known for, which means we'll talk about how to investigate it, how do I measure it, what should I be asking for, what should I be looking for and paying attention to, how do I interpret those findings, and then most of our time today will be spent on the third I, which is intervene.

Dr. Andy Galpin

What are all of my options for either reducing my likelihood of developing poor bone health? If I've already developed it, how do I reverse it? And then if I have had a break, how do I accelerate proper healing? When we think about bones, we tend to think about them as the structural component. In other words, they're the thing that keeps me up, they're the thing that keeps me moving, and they keep me alive. That is true. But I want you to think about them more like body fat. What do I mean here? Well, if I were to ask you about your body fat, it provides a little bit of structure. It provides some insulation. It does those things. But the real true reason

you have body fat is so that you have backup energy supplies. In other words, when you go into a low energy state because you're moving a lot or you're eating few calories, you will then take some fat out of the stored tissue, put it in your body, and use it.

Dr. Andy Galpin

In fact, this is one of the reasons why some people will store more body fat than others because they're particularly good at this preservation mechanism. Bone has a similar property. So outside of the structural thing, the second most important thing that bone does, it is your backup supply. But instead of being for energy, it's for minerals, and most specifically, calcium. Now, why would I develop an entire structure and system in my body just to have a backup supply of calcium? Well, go back into season one of this podcast and listen to the episodes on muscle contraction and cardiovascular function. In that, what you realize is all of muscle requires calcium to contract. Your skeletal muscle has to have it. Your heart has to have it. It is a critical component to high quality, fast, and successful muscle contractions. If calcium gets low in your body, you will die. Your heart will stop beating.

Dr. Andy Galpin

Your muscles can contract, but again, you're going to die because your heart stops. And so your body came up with a very unique and thoughtful way to make sure you never, ever, ever, under any circumstances, run out of calcium. See, if you ran out of body fat, you could survive. You could get energy from other places, in your liver, and muscle stores a little bit, and so on and so forth. You have no options, though, if you run out of calcium. So what your body will do is it will preserve muscle contraction and being alive, quite frankly, over top of bone quality. So when you get in a situation when you don't have enough calcium ingestion, in other words, you're not eating enough or you're not absorbing enough through your gut, and your internal calcium supplies start to get low, your body will turn to bone and start leaking it and pulling it out of the bone. And if this process continues, then therefore you lead to low bone mineral density or low amounts of calcium in your bones, and you have brittle bones and you're frail and they break a lot.

Dr. Andy Galpin

That sucks, but the reality of it is that is better than you dying. And so that hierarchy, if you will, for calcium supply is there on purpose. And so your bones are going to pay the consequences of either poor gut health, poor nutritional status, or other rationale that would lead to that same exact scenario. So the first way we need to frame this is poor bone health is, in some sense, poor mineral health. So we have all these storage places. In terms of the minerals, as I just mentioned, calcium is the big player here. In fact, 99% of the calcium in your body will be stored in your bones. Some of it is in your blood, but this is usually because it's being transported back and forth. If you were to look at your calcium levels in your blood from a traditional blood test, we

can start to see insights of your bone health. Now, it's a little bit tough for us to diagnose exactly what's happening here because here's the example.

Dr. Andy Galpin

If you're in a situation in which your intake or absorption of calcium is low, your body will recognize this, and it'll start pulling it out of bone. This will actually lead to a rise or an increase in calcium concentrations in your blood. So if you're looking at your blood work and saying, "Wow, my calcium's really high. I must be in a great spot. I have a ton of calcium," it's possible you're in the opposite situation. This is potentially a sign of a poor calcium status. And so this is sometimes confusing because people will see this and say things like, "Hey, my doctor told me to take a calcium supplement, but my calcium numbers are really high in my blood. This doesn't make any sense." This is what that physician is potentially looking at and saying, it's high in the blood where it shouldn't be because it's low in the body. If that little bit of backwards math makes sense. Okay. Now, in addition to calcium, there's a couple of other things that are going on in your bone from a mineral perspective that we need to pay attention to.

Dr. Andy Galpin

The next is phosphorus and then magnesium. Now, about 60% of your magnesium in your body will be stored in your bone. So there are other things like vitamin D in your bone in very small amounts. But the role of vitamin D relative to bone health is not necessarily because you need a lot of vitamin D in your bone. It's other things. If you don't have enough vitamin D, you'll get about a quarter of the calcium absorption through your gut that you would if vitamin D is sufficient. Your bone cells actually directly do have vitamin D receptors on them, so there's actually another direct act you have there. It's also why in the 1930s, once scientists and physicians started to realize what was going on with rickets, they started fortifying milk and cereals and things like that with vitamin D. And you might be thinking, in fact, to this day, here in America at least, most of those products are still fortified with vitamin D, and that's because those are a really high source of calcium.

Dr. Andy Galpin

And if you co-absorb that vitamin D with that calcium, you'll get more of the calcium, and that started helping things like rickets because of the vitamin D intake. So if you ever wondered why the heck are all my cereals and milk fortified with vitamin D, many reasons for that, but this is at least where that idea started with. Okay. So big minerals we want to pay attention to, calcium, phosphorus, magnesium, and another role of vitamin D here. There's other things going on in terms of minerals like fluoride and zinc and sodium, potassium, iron, and things like that, but we're not going to spend a lot of time talking about those. All that then to say, and I mentioned this a little bit earlier, this is why when we think of measures of bone health, we tend to use the phrase bone mineral density or BMD. If you've ever had a bone scan, if you've ever heard

people talk about it, and you wonder why it's actually called mineral density, that's what we're looking at.

Dr. Andy Galpin

The more minerals in total in your bone, generally, the more dense your bone is, the less brittle it will be, the less likely it is to break. It's generally considered to be healthier. Those are not absolutes, but you can see the basic logic that's applied there. If your nutritional status or other things are going on and you have to pull your minerals from bone, they become less dense, more likely to break, and now we're in that other side of the equation. So when we're talking about overall bone health, this is really what we're getting at. We need to have a lot of minerals, specifically calcium, so that it can stay dense and not break. Now, your bones are highly metabolically active. Again, people generally don't think about it. They kind of just get this idea that my bones are there. They break or they don't break, but they're just moving me through space. They don't realize that they're there for mineral deposition for the most part.

Dr. Andy Galpin

They're also not realizing that they are there for high metabolic activity. So the way that you'll hear this phrased is bone remodeling or bone metabolism. We use them a little bit interchangeably. But this is happening constantly. In fact, I remember thinking about this when I first had my little kids, but in the first year of life, you'll 100% replace your entire skeleton. The turnover happens really, really rapidly. By the time you're an adult, it's more like 10% per year. Somewhere in the neighborhood of 5 to 10% of your bones are being remodeled right now. So it is not a metabolically inert place. It's happening at an equivalent turnover of not the same, but many other systems like your skin and muscle and things like that. So it's constantly being remodeled. Now, that remodeling process is almost exclusively responsible for short and long-term bone health. In other words, if you develop poor bone health, you have low bone mineral density, and you have that because of basic math problems.

Dr. Andy Galpin

You're either breaking down too much bone or you're not remodeling enough bone, bringing in new additional bone, or some combination of that. Now, that remodeling process is driven almost entirely by demand. You'll hear this called Wolff's law, but it's specificity. When we talk about this from an exercise or strength and conditioning perspective, we say a specific adaptation to an imposed demand. It's the SAID, S-A-I-D principle. So if you want to get bigger biceps, you lift with your biceps. If you want to get better at shooting free throws, you shoot free throws. If you want a lot of bone turnover, you need to challenge bone. It is as simple as that. This is critically important because this will directly explain what caused the bad bone health and what we do to solve the problem. So the specifics of how this remodeling work ultimately tell us what intervention we should go for. Another way to think about this is, am I having a problem

with too much breakdown?

Dr. Andy Galpin

If so, there are a different set of interventions. Am I having a problem with not enough remodeling? If so, there's a different set of interventions. So hopefully that all makes sense. A little bit more detail here, and we'll get directly into some of these examples. This remodeling process is regulated by a whole host of factors, but the two big ones are called osteoclast and osteoblast. Now osteo means bone, and I'm going to be a little bit annoying here just because I actually remember being an undergraduate learning about osteoclast and osteoblast for the first time, kind of dozing off a little bit, picking back up somewhere between in the middle of the lecture and being like, "Wait, did she just say blast or clast?" And I would kind of half pay attention, and then I would get completely confused because the words sound so much alike. Now, if you're in a classroom or you're watching this video, it'll probably be a little bit easier to follow along with.

Dr. Andy Galpin

But if you're just listening to the audio blast class, oh my God, you're answering emails or your kid just talked to you, you're going to get confused or potentially get confused. So in order to do that, I'll be a little bit annoying with this particular way I'll describe them. Clast is with the C. Clast. Think of clast as red. All right? So when you hear clast, think red. Blast, b-b-b, with a B, is green. So clast and blast, red and green. Now, I don't like the connotation of the colors there. Red is not bad. Clasts are not bad. Green is not the opposite. But let's pull those apart in your brain by attaching them to a color. Okay. Now, osteoclasts, the red ones, are responsible for breakdown. Just like in muscle, muscle breakdown is not bad. Bone breakdown isn't bad. You have to have it to remodel. You can't just add more on top of it. It's also the way we get rid of dysfunction or breaks or problems in the area.

Dr. Andy Galpin

Right? So we're cleaning house here. So osteoclasts lead to bone breakdown through a handful of mechanisms, but the basic principle here is it secretes a bunch of acid onto your bone. They kind of live in these little divots or grooves that go along the outside of your bones, and when they get activated, they secrete a little bit of hydrogen ions, which is acid, onto the bone matrix. It dissolves it, which releases the minerals. So step number one in remodeling or bone metabolism is secrete that acid, release those minerals and that calcium into the blood. Okay? Again, it's not only happening here just to remodel muscle, but this is just simply like the bank teller opening up your security vault there, where you went in and said, "We need some more money out. We need some more calcium." And the bank teller just says, "Okay, great," and opens up the door. It's not a negative thing. They're just opening up the door, releasing some of this calcium back in.

Dr. Andy Galpin

So clasts, red, break it down. Blasts, B, green, come in and do the opposite, where they're going to actually secrete new bone. They're going to start off by making what's called type 1 collagen. They're going to use osteocalcin and alkaline phosphatase and things like that, which will come up a little bit later. But those things provide the scaffolding that then you can pour the calcium and the phosphorus into that it can build around. So the two-step process, break down, clast, rebuild with our blasts. Okay. So again, there's different dysfunction, different diseases, and different things that lead to an accelerated or exaggerated activity of our red clasts and some that suppress our green blasts. Right? So then again, one more time, our solutions will depend on where the problem is actually lying. Now, I mentioned earlier your lifestyle is going to determine somewhere between 20% to 40% of your bone health.

Dr. Andy Galpin

And so what are some of these actual factors that happen that lead to accelerated bone remodeling or bone metabolism? Well, the very first thing we want to think about is that calcium intake and status, and I will double tap on that here pretty soon. Other things that play a big role are parathyroid hormone, another one called calcitonin that actually comes from your thyroid, vitamin D, as I mentioned. Particularly when you're a kid, you want to be thinking about growth hormone. You'll often see this as a common medical strategy for kids who are not growing at a normal rate, where they can give them growth hormone to where they can actually probably not accelerate and be any taller than they would have been, but at least they can get to that genetic potential rather than be stunted. There are other things that are what we'll call bone-derived cytokines or growth factors. The big one that you'll hear commonly is called interleukin-6 or IL-6.

Dr. Andy Galpin

So there are many other things, but these are the big rocks. And so how this stuff can manifest itself, I gave you a little bit of the calcium example earlier, but this is really what it looks like. If you are in the case of low calcium status, your body will secrete a bunch of parathyroid hormone. Now, osteoclasts, the Cs, the red ones, don't have parathyroid hormone receptors, so it kind of works with this indirect mechanism, but it actually goes to the blasts. The blasts then secrete things like interleukin-6, which then turn up or off the osteoclasts. So one way or the other, your body has realized we don't have enough calcium. It secretes parathyroid hormone. That then leads to more calcium being put back into the blood. Now, this is fine if you have enough in bone or your parathyroid isn't going crazy, if it's not being artificially or otherwise pressed too much. So you could even be fine with your calcium status, but if you have issues with thyroid or parathyroid, it could lead to problems like that.

Dr. Andy Galpin

I could give a bunch more examples with the growth hormone or calcitonin and other stuff, but

we don't need to know them all. What we just need to realize is, again, conceptually, how this is working and why my things like physical activity, metabolic health, and nutritional status, why they're actually determining my bone health. With all that in mind, unlike body fat, unlike skeletal muscle, bone is unique in the fact that by far, by a landslide, and it's not even close, the most important thing you can do for bone mineral density is to make sure you reach your genetic normal peak. Another way to say this is the most common reason for poor bone health as an adult is because of not reaching bone mineral density peak as a child.

Dr. Andy Galpin

You can do something about it. In fact, when I was in school, we were told you can't. These are recent findings that you can actually do this, but you still are never going to reach probably where you could have been had you not done it. This is oftentimes why people will refer to things like osteoporosis as a childhood disease. Now, you will almost never be diagnosed with osteoporosis until you're an adult, almost never until you're over the age of 50. But they call it a childhood disease because, again, the biggest thing that caused you to have osteoporosis when you were 60 was what you did between ages 10 to 15. I don't want this to come off the wrong way. That doesn't mean you can't do anything about it if you are 50 with bad bone health. You can. But we have to emphasize high-quality bone health as a developing child, or we're always going to be chasing our tail after that. And this is exactly why.

Dr. Andy Galpin

As a developing child, you're increasing both bone length and bone mineral density. You're growing, right? And any of you that have had kids or been around kids will know this, right? They'll shoot up by-- In fact, both of my kids increased and grew three inches this year, almost identically, right? Different ages, one boy, one girl, but they went up by three inches. So you're getting longer bones. But by the time you've basically finished puberty and those growth plates fuse, your bones are as long as they will ever be. But your bone density can continue to change. And so I'm going to give some numbers here just to provide a little bit of context. The numbers themselves don't matter a ton, but so you can conceptualize how big of a deal this is. Right? Now, the average man, in terms of the amount of grams, how much bone you total have in your body, if we gave it a number and called it 1,500 grams.

Dr. Andy Galpin

Women, again, on average, may sit at something like 1,200 grams. So men are generally bigger. They have more total bone mass. Okay, that's great. You're probably going to reach that peak mass somewhere around 20 to 25 years old. Again, for men, let's just call it 1,500 grams. For women, let's call it 1,200.

Dr. Andy Galpin

After that, men tend to hold onto that bone mass pretty good for the next 10 to 20 years. It'll start

to slowly decline around 50 years old or something like that, and by the time they hit, say, 90 or 100, they went from a total bone mass of 1,500 grams to, like, 1,000. Right? So they lost a third of their bone mass over time. With women, it's completely different. So if you started off at that peak of, say, 1,200, you're going to start declining around menopause, and you might go from 1,200 to 700 in a five-year span. So you see this just absolutely cataclysmic drop in bone density during menopause. And then from there, you'll still continue to decline to where you're, say, 500 or less by the time you're the same age as men. And so we need to emphasize bone health in men and women, but we really, really need to emphasize it in women, particularly during the menopause window. And that's why the vast majority of the research and the funding and the public advocacy has come with bone health in women, and it is completely understandable.

Dr. Andy Galpin

But we actually have to rewind the story. Because, as I said, while your peak bone will come in your 20s, it is directly explained by what you did in the decade before. So what do I mean by this specifically? About 40% of your bone mineral density increases will happen during your puberty range, which is usually, like, a two to three-year window. About 95% of what you're going to get as an adult is determined by what happens during this short timeframe. So what that really means is, if at all possible, for girls ages 10 to 14, roughly, you have to really make sure that they're eating a reasonable quality. I realize what that sounds like for trying to get a teenage girl to eat broccoli and things like that. But you got to do your absolute best. Probably more important, though, and the literature would support this, is exercise and movement for girls during this time. So whatever it takes to get these young girls moving, getting them at least trying to eat pretty decent, is going to have implications for the next 60 to 80 years of their life.

Dr. Andy Galpin

The total body bone mineral changes per year are going to look something like this. For girls, say an average nine-year-old girl has about a 50 gram increase per year. That's going to five or six X over a couple of year span. So a nine-year-old might have 50 grams per year that's being added to their bone mineral density. By the time they're 12, they're adding something like 300 grams per year. And so you can just see how this is going to multiply across not only all of their bones, but across the years if their rate of increase, instead of being 300 grams per year that they're adding, is only 150. They're just never going to get to that total peak that they need to get to. For boys, it's a similar story, but it's way less dramatic. Instead of seeing these five or sixfold increases in the rate of mineral growth per year, it's more like a doubling. Right? So they go from adding 100 grams a year to 200 or 300 or something like that.

Dr. Andy Galpin

So again, it's important for both, but it's absolutely fundamental and critical that we maximize bone mineral growth during this range or this age for young girls. So hopefully by this point,

you've realized the scope of the problem. You know what's exactly happening. And now we can start transitioning into how do we measure these things? How do I identify where we're at? And then what are the different interventions? Today's episode is sponsored by AG1. AG1 is a vitamin mineral drink with probiotics, prebiotics, and adaptogens. Initially, I was extremely skeptical of AG1, as I am with all supplement companies. But after months of discussions with their lead nutrition scientist and the general team at AG1, I've been impressed by AG1's commitment to sourcing the highest quality ingredients and constantly updating their formulas to have the right ingredients in the optimal amounts. AG1 also rigorously tests their products 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 stamp. Now, most people in the performance space talk a lot about macronutrients like protein, carbohydrates, and fats, and these are obviously critically important. But so are the micronutrients like vitamins and minerals. And even if you're eating a healthy diet, it's often hard to get enough of these vitamins and minerals, along with the probiotics, prebiotics, and adaptogens to keep your body performing at its best. It's for these reasons and many others that I personally take AG1 almost every day. Now, it's of course not a replacement for eating whole, healthy foods, but it is a great way to make sure that you're plugging in any gaps in your nutrition to improve your energy, bolster your immune system, and just generally help promote a healthy gut microbiome and more. 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.

Dr. Andy Galpin

Again, that's drinkag1.com/perform to receive five free travel packs plus a year's supply of vitamin D3 plus K2. If you were to look across the scientific landscape, you would find about nine different factors that globally go into people having poor bone health. I broke them up into what I call modifiable and non-modifiable. The non-modifiable ones, there's just two of them, and I'm not going to spend much time on them because you can't do much about it. The first is actually things like genetics. There's a big component to that. Earlier, we've talked about that number, and so great. Moving on past that, the second non-modifiable one has historically been age. As I discussed earlier, men and women seem to lose bone mineral density, especially from 50 years old and on, and that is just sort of thought to be a part of life. That said, there have been significant and serious challenges to this thought, so much so that I actually think that I can make a decent argument to take this off the list entirely.

Dr. Andy Galpin

What I'm saying is there is this classic thought of being like, regardless of what you do, you'll just

lose bone mineral density because you're getting older. But now, some more recent research has indicated that the loss of physical activity that happens with aging directly explains the reduction in bone mineral density. Such as to say, if you were to simply keep your physical activity at the same level, you might not lose bone mineral density just because you're getting older. The only exceptions to this are things like menopause. Now, what happens with menopause, as people are mostly aware of, is women's concentrations of estrogen go down dramatically and oftentimes pretty quickly. Estrogen keeps osteoclasts, the red ones, in check. So when the estrogen goes away, those clasts run kind of unmitigated and unmanaged, and so bone breakdown happens at a really high rate. So if we're looking at interventions for post-menopausal women, one of our first stops on this journey is how do we reduce osteoclast activity?

Dr. Andy Galpin

Rather than even worrying too much about what's happening with the blasts, we just have to slow these clasts from, again, running wild. Same thing actually happens in men. It's not called menopause. We often call it andropause, and that's when that has that large drop in testosterone. Now, it's actually something that people don't really realize is that testosterone and estrogen kind of follow the same path in men. So when we see this big drop in testosterone, we also see a drop in estrogen for men. So this is why their bone mineral density can go down as well, especially if they have a large pronounced drop in testosterone for any number of reasons. It's not nearly as pronounced as women, but it does happen there. So I will give you those ones are, I don't think we can make an argument that menopause only happens because you stop being active or anything like that. I'm not aware of any ability to stop menopause from happening, and I'm not sure you'd want to even do that.

Dr. Andy Galpin

So these ones I will give you, but the age in general, I will argue against and hopeful for more research to come out soon on that. But those factors we would generally call either non-modifiable entirely or minimally modifiable. The modifiable ones I'll call the Big Seven. The first one we'll talk about is actually what are collectively called environmental toxins. Now, you can bucket these into three big categories. The first ones are the heavy metals. The most common ones, aluminum, mercury, lead, cadmium kind of fall into this category. Now, the next category are what we generally call chemicals, things like BPAs, phthalates, antibacterials, pesticides, and things like that. And then category three are air pollutants. So particulates, nitric oxides, sulfur dioxides, ozones, and things like that. I'm not going to get many more just in the sake of times into these environmental toxins. I would recommend you go check out a great episode of the Huberman Lab podcast, where Andrew covered a lot of environmental toxins and microplastics and things like that.

Dr. Andy Galpin

And so you can go learn more about this general category there. But again, for the sake of wanting to focus on the interventions, we're going to move on past environmental toxins for now. The next big category, so the second of our Big Seven, are what I'll just call diseases, and these are things like metabolic disease. There is a well-documented relationship between diabetes and hyperthyroid and bone mineral density. So I just collectively call those things metabolic diseases. You'll see the same thing actually more recently for gut health diseases. Celiac disease and IBS also have a documented negative influence on bone mineral health. And then another category that people all don't talk about very often, and also covered pretty recently on the Huberman Lab podcast, is oral health. There is a really strong connection between not only the health of your teeth, but how your oral health will influence whole body bone health.

Dr. Andy Galpin

And so you can, again, see more of those things later. So number one was environmental toxins. Number two were these collective group of diseases. Number three are what I call drugs and medications. Alcohol and smoking fall into this category. I don't think I need to stretch your imagination to realize those are generally bad for everything, and of course, then they're bad for bone. A more controversial one that I'll tread lightly on here are things like caffeine, and specifically cola. And really, what I'm talking about is the long argument about how caffeine and sodas, whether they're diet or not, influence bone health, particularly in kids. You can dive into that hornet's nest as much as you'd like, but I think most of us would agree at this point, copious amounts, excessive amounts of those substances, particularly caffeine in kids, is not good for bone health. But the ones that people will be a little bit more surprised about that are not in the medical community are things like gastric reflux medications.

Dr. Andy Galpin

Now, this probably is ringing some bells because I just said earlier about how things like IBS and celiac disease are connected to bone health. And then I talked about even earlier than that how there's various gut health protocols we can go through to help bone mineral density. So you're seeing a pretty strong connection here between altering various aspects of our gut microbiome and bone health. The other one that people are often really surprised at are the corticosteroids, so prednisone being the most well-documented one. Most physicians are very aware of this, but the general population is not. There is an incredibly strong set of literature, unfortunately, showing a connection between prednisone use and bone mineral loss. So you want to be really careful about, again, any corticosteroid, but prednisone really has a documented negative effect on bone health. So always make the best medical decision for you based on a number of factors.

Dr. Andy Galpin

It's always a choice. Don't let me help you decide what you do for your medicine, nor your physician. You two work that out, how you want to deal with it, but something to really pay attention to. Okay, so in terms of our big seven, that is drugs and medications are the third category. The fourth one is sedentary behavior or lack of physical activity. I'm going to hammer you with this a little bit later, so we're going to move past it right now and get into the fifth category, which is malnutrition. The three big things you're going to jump out from malnutrition's perspective are things like being underweight and anorexia. You should be able to make some leaps of faith here with saying things like, "Okay, if I'm missing vitamin and mineral nutrient intake because of simply not having enough calories, that's going to affect bone mineral health." And that is exactly what happens at this point.

Dr. Andy Galpin

So from a micronutrient perspective, the vitamin D and calcium, magnesium, zinc, boron, copper also highly associated with poor bone health if they don't come in sufficient amounts. And then the other one that will pop up the most in the literature is a really bad omega-6 to omega-3 ratio. So these are your fish oils, if you will, and seed oils and things like that. Just making sure that ratio is reasonable and not making sure the omega-6s get really, really, really high, especially in the presence of low omega-3s. That will have a pronounced impact on bone health. Okay. The third one in this category, so outside of just being underweight and/or the combination of micronutrient insufficiencies or deficiencies here is high acidity. Right? Now you should be able to go back and say, "Oh, okay. I remember the way that osteoclasts, the red ones, work is they secrete a bunch of acid onto bones, and that breaks them down."

Dr. Andy Galpin

Therefore, if I'm in this continuous, perpetual, highly acidic environment, it'll probably have a similar effect." And in turn, it actually does that. And so making sure that we're not being in this ultra-acidic environment from a nutritional perspective is another thing we can do to pay attention to make sure that our bone health stays where it needs to be. So those are the first five we want to tackle. The next two are chronic stress and bad sleep. And so let me talk about those things independently. Chronic stress, if you look at the research on things like anxiety and depression and PTSD, you'll see a strong correlation between those and poor bone health. Now, that's just correlation. What's the mechanism? What's causing it? There's a lot of stuff I could talk about here, but I'll give one tangible example that I think most people will resonate and connect with. And these are things that I'll globally call cortisol dysfunction.

Dr. Andy Galpin

Now, I'm not really a supporter of adrenal fatigue, but cortisol dysfunction is a very real thing. There are actual diseases like Cushing's disease, and this highlights it really well. So Cushing's

disease is basically just a cortisol disease. There have been studies finding, reporting that 80% of people with Cushing's have poor bone health. In fact, over 50% of them have actual osteoporosis. Now we know osteoporosis is really common in the general population, but it's not this common. So clearly, just looking at that relationship, saying people that have cortisol dysfunction in this disease state at a really high rate have poor bone health, so potentially there's something happening. Well, what do we know happens? We know that cortisol will inhibit osteoblast activity, so the B, the green ones. It'll block the formation of new osteoblasts from stem cells, and it promotes osteoblast apoptosis. So it makes the blasts you have not work, it makes you not be able to create new ones, and it makes the ones that you currently have die.

Dr. Andy Galpin

On top of that, cortisol also stimulates and activates osteoclasts, the red ones. It then further promotes calcium release and also blocks calcium absorption. So it has a bunch of different mechanisms in which it can alter bone quality. Now, as always, when we talk about anything that has a hormetic stressor, and cortisol being one of the ones people tend to pop up with, it's the most in the lexicon. People hear about it, they blame it a lot. It's not all negative. This is a really good thing to happen in short, high bursts. Why? This stimulates bone turnover. This keeps your bones healthy. This is what allows you to have high-quality tissue. It allows you to put minerals in your system. This is a great thing. The problem always with cortisol, and the problem always with stress, and the problem always with hormetic stressors, are when they're at a low to moderate level chronically. So you can imagine doing something like exercise, where it releases a huge amount of cortisol really fast, stimulates this growth, stimulates turnover, and goes back down to baseline.

Dr. Andy Galpin

However, if it's persistent for a long amount of time, and you're continually blocking these blasts and continually accelerating these clasts, then we're going to eventually lead to low bone density overall. So this is just one example how something like a psychological stressor could lead to a physical consequence, and in this case, directly contributing and causing poor bone health. Obviously, any time we bring up cortisol, the reality of it is things get much more complicated than what I just described. But I think this highlights just one area of how we could think about stress management and your doctor trying to tell you, "Hey, you got to get your stress under control," and you're thinking, "Well, how is that affecting my bones?" This is one way, or in fact many, of how that could be happening. Now, part and parcel to that, oftentimes in combination with chronically high stress, is bad sleep.

Dr. Andy Galpin

They don't have to both be there, but bad sleep has a really, really negative effect on bone health. This is actually coming out really recent. In the last couple of years, there's been a

handful of really big randomized control trials come out. In fact, one particular paper I want to highlight, titled "Sleep Disruptions and Bone Health: What Do We Know So Far?" did a really nice job of laying this out, but this is a really deep, large landscape of literature. There's a really clear differentiation between those who sleep less than five hours per night and those that sleep seven hours per night or more. You're talking about an odds ratio of 1.22 for low bone mass versus 1.6 for osteoporosis, and you can kind of think about this as almost a 63% increase in risk of developing osteoporosis. It doesn't mean you have a 63% chance of developing it, but your risk has gone up by 60-plus percent if you're sleeping an insufficient amount.

Dr. Andy Galpin

So total sleep duration itself, right out the gates, leads to a lot of problems. Okay? Now, it does this a lot of different ways, but one of the things that's been learned more recently are things that are called clock genes. Now, these are a whole host of genetic influences relative to things like not just total sleep, but circadian disruptions. So this is sleeping at irregular times, this is sleeping at irregular schedules. This is night work or shift work or things like that, right? Disturbing your circadian clock independent of time. Now, we know these clock genes have existed for a long time, but what's only been shown recently is that they have a direct influence on bone cells. And so this part of the mechanism story was never around before, where we're like, "Well, we know that, hey, bad sleep is bad," and then all things that are generally bad for your health tend to contribute to everything else.

Dr. Andy Galpin

But the direct discovery of these clock genes in bone cells was a huge breakthrough of understanding the mechanisms by which this happened. All right? Now, the way that this happens, and you can actually intuit a little bit of here, is we know that there's diurnal variations in bone turnover markers, which is to say the amount of bone turnover happening in the morning is not the same that's happening at night. Right? It changes throughout the day, and we knew that. We also knew that that was happening in concordance to circadian rhythms. And so now having those clock genes as the direct, or one of the least, the direct explanations there tied that story together. Okay? So sleep duration is a problem to pay attention to, and sleep circadian rhythm is also something to pay attention to. So to summarize all that up, there are seven, in my opinion, big categories of modifiable factors that lead to poor bone health.

Dr. Andy Galpin

Those big seven were environmental toxins, a collective range of different diseases, various drugs and medications, physical activity or sedentary behavior, malnutrition or poor nutrition, chronic stress, and then finally, bad sleep. At this point, hopefully you've learned a lot about how bones work, what they really are, how they're playing a role in multiple areas of your physiology, not just hard things that are inert and carrying your bag of cells throughout this entire world.

Hopefully, I've also convinced you to pay more attention to them. In fact, what I just covered is a lot of things that you'll need to do or want to do to maximize your overall bone health. You don't actually need to get anything tested if you want to just take advantage of those seven modifiable areas. But that said, some of you are still going to be interested in directly testing your bone mineral health, and I would encourage you to do that, and so I'm going to lay out really quickly what your options are across a range of accessibility and cost.

Dr. Andy Galpin

Starting right out the gates, you can actually learn a lot completely free. There are a number of options you can do. There is what's called a FRAX, F-R-A-X. It's a Fracture Risk Assessment Tool. I actually have directly linked one to you in the show notes so you can go. You can enter a bunch of information in there, and it will give you your 10-year fracture probability. Obviously, any time we're using a questionnaire and not direct testing or imagery, that we're going to lose some accuracy, but this is scientifically validated. In fact, if you look around, you will see the F-R-A-Q, the FRAQ used all over the place. It's extraordinarily common in bone health, rather. If you can, though, whether you're paying cash or you can get your insurance to cover it, hopefully you have accessibility to it. What you're probably looking at here in terms of imagery is what's called the DEXA scan. Now, this is often abbreviated as D-E-X-A or just simply DXA.

Dr. Andy Galpin

Most of the general recommendations are going to tell you that if you're a woman over age 65 or you're a man over age 70, that you should just get a DEXA scan regardless. I am way more aggressive in this, though, as I told you at the very beginning. The reason is I have personally put people through and ordered hundreds of DEXA scans, athletes, non-athletes, our male clients, our female clients across my personal coaching programs. And a lot of the times, we see people come back who are generally healthy. They're lean, they're active, they're doing a bunch of stuff, they're young, and they still have really low or poor bone quality. And so I think that if you consider the cost, you're generally looking at somewhere in the neighborhood of \$100 to \$300 US for a DEXA scan. Again, most of the time your insurance will cover it. If you're a 30-year-old, you might have a hard time getting insurance to cover it.

Dr. Andy Galpin

Sometimes, 100 bucks is just not even possible for you. But if it is, a lot of people can get their way to \$100, \$150 to get one of these scans. And so I actually honestly recommend people getting this as soon as they possibly can. Certainly by the time you're 40, I think men and women should have this. Because if you can catch this, imagine you're a woman and you have not gone through menopause yet, and you have no idea. You're kind of physically active a little bit. Maybe you've gone through spurts, you've worked out, then you kind of fell off the train. You're back in a little bit. You eat pretty well, but not tremendous. You might already have

osteopenia or porosis. You could also be great. But if you are even okay or slightly low, and then you get that known dip that comes with menopause, you could be in pretty serious issues here, where if you had five or 10 years to accelerate your bone quality before the menopause hit, this is massively changing your life.

Dr. Andy Galpin

So for all these reasons, I think it's actually, personally, I would recommend getting it a lot sooner, earlier in life than 65 to 70. I think that is-- I would be willing to bet those numbers are going to change. Recommendations are going to start coming way down to scanning way earlier in life. But me personally, if at all possible, if you live in a region where you have access to these things, which they're all over the place, and you could possibly afford it, I would recommend this as a very low risk, a fairly cheap, and a high potential quality result. That being said, you also have other options in terms of imaging. If you really think you have osteoporosis or osteopenia, you can't get that diagnosed with a normal DEXA scan. So for example, when I order this for the people I work with, we're generally just looking at total bone mineral density, which is not what's going to qualify for osteopenia or osteoporosis.

Dr. Andy Galpin

So we order this, and we're looking at body composition, total mass, and various things like that. If your physician really thinks you're at risk for some of these things or you are concerned about it, then you actually need to order a different scan that's more specific to the pelvic region, the hip region, the lumbar region, and things like that. That's for some technical, official reasons. But I'm saying that because, again, having had many clients go through these and come back and they go, "Oh my God, I have osteopenia." I'm like, "Whoa, you don't have osteoporosis yet. We need many other pieces of information to fill that in," but it's a nice starting place. It's a flag. If you go through a normal DEXA scan that are available, again, kind of everywhere, and you do see numbers that are poor, which I'll cover in one second, then that might lead you to go to your doctor and say, "Hey, I got this initial scan."

Dr. Andy Galpin

Now I actually want to see if I can get checked out for osteopenia if I have it." So I don't want you to over-interpret DEXA scans that way. Now, the DEXAs have been around for a long time, but there are some emerging technologies that look to offer some really unique solutions that DEXA has always been limited by. The one that pops out the most is called QCT. This is called quantitative computed tomography. Don't worry about all that. But basically, it allows you to go in and individually look at bone segments. And so when you generally get a DEXA scan, you're going to get this total body score. And the way that it works is you're going to lay on a machine. It's going to shoot some things up through the bottom of your body, and it's going to try to connect those to the imaging part of the machine on the top. Which is a way to say they're not

actually giving you bone mineral density. They're just kind of giving you a 2D image and then estimating circumference and diameter and area around that.

Dr. Andy Galpin

Well, this QCT stuff allows actual volumetric density. So it's going to come in different units, like milligrams per centimeter cubed rather than squared. If you have no idea what I'm talking about there, don't worry about it. If you're a math aficionado, you're going to be like, "Oh, wow, I picked up on what he said there." But you can get a whole bunch of bone mineral density specificity that we can't right now get on DEXA. Most of us, though, are going to use that DEXA scan. A lot of people have already had this, and they really had no idea. The DEXA and bone mineral density is notoriously difficult to interpret, I'll say. A lot of times you get it back and Maybe they've color-coded it for you, and you got a green, so you're like, "Great, that's good." Or it's red, so you think it's bad. But it's not an intuitive response where something like this is how much muscle you have, this is your body fat.

Dr. Andy Galpin

People are kind of comfortable with those numbers. The bone mineral density results come back in a very confusing fashion. So let me break it down for you really quickly. How do you interpret these results? Well, first of all, if you're going in to get a DEXA scan, generally, you're going to see just that total body number. If it's more advanced, and depending on the scan that the operator selected, ideally, you get things like your lumbar spine, your total hip, your femoral neck, and then your actual forearm. If you can have those individually isolated, that is advantageous, and that is what a physician, again, would look at if they're trying to truly diagnose osteopenia, osteoporosis. But nonetheless, those scores are going to come back, and you're going to see it represented as two things. Well, three things. Total density, if you will. But it's going to be not given to you in a number, but it'll be given to you in what's called a T-score and a Z-score.

Dr. Andy Galpin

Okay? Now, T-scores are going to come almost always if you are a post-menopause male or female over the age of 50. All right? And why they do that is they're going to say the T-score represents your value and density relative to a young, healthy person. So if you're 50, what does your bone density look like relative to a 22-year-old of the same sex and the same ethnicity? So the way that this is reported back to you is in the format of something like this. If your score is greater than negative one, then you are in the upper 15th percentile. And you probably just heard all that and just said, "What the hell did he just say?" Okay, so T-score is relative to the 22-year-old best version of yourself, theoretically. If you are at a score of zero, that means you're the exact same score. Well, that's awesome because it means, now, theoretically, again, as an example here, you have the same bone health or quality or density as a 55-year-old as you did

when you were 20.

Dr. Andy Galpin

That would be tremendous, right? Because it's supposed to go down with age. If the score is one or one and a half, that means you have more than the average person your age and sex and ethnicity, which would be great. In fact, even if it's a little bit negative, negative 0.5, negative one, that still puts you in the top 15th percentile. Okay? So again, a little bit weird to say, but a score of higher than negative one, so negative one to zero, or even literally positive, is the best possible score here. If you score somewhere between that negative one and negative two and a half, now you're in what's called osteopenia. So that is actually the definition. The one, by the way, is one standard deviation. The two and a half is two and a half standard deviations from that norm. So 85 percentile or higher for the top score, you're in the 14% of people are going to be in this osteopenia thing, and if you're more negative than negative two and a half, so you're more than two standard deviations away, then you are now considered osteoporosis, pretty much full stop.

Dr. Andy Galpin

The risk of a broken bone increases, about doubles actually, per point on your T-score. So if you go from a negative one to a negative two, you've basically doubled your risk of breaking a bone. If you go from a negative two to a negative three, you've doubled it again. The Z-score is more like you to you. Right? If you're younger, by the way, you may not get a T-score at all. So if you're a 25-year-old, 35-year-old, you might just straight have gotten this T-score because it's like what's the point of giving you a Z-score when you're already that age? Right? So again, if you're over 50 or 55, you'll get a Z-score and a T-score. But if you're younger than 50, you might just get the Z-score. So the Z-score is how do you score relative to the same person your age? That's what it means. Again, your age, your sex, your ethnicity. And so again, if you're zero, you're neutral. If you're one, that means you're one standard deviation above the person.

Dr. Andy Galpin

If you're less than-- It's the same scoring criteria, right? So negative one to two and a half to two and a half, all the way down. So someone greater than negative two means you're pretty significantly lower than where the average person is your age. In terms of actual numbers, I wanted to throw this in as well. You guys know how I always like to put in kind of world records when I can. The highest I found in the literature from an absolute perspective, most men are going to be somewhere between 1.1 to 1.2 grams per centimeter squared. Again, we're not talking Z-score or T-score here. We're talking about absolute total number here. 1.1 to 1.2 is normal. I did find a study that reported people at 1.7, which would, your T-score would probably be five at that point. I don't know. But that's really, really high up there, right? Women are generally about 1.1, so they're a little bit lower than men.

Dr. Andy Galpin

And again, I'm talking about men and women in their 20s right now for the most part, because that's where you're going to be at your peak, right? And the highest female number I came across was 1.5. I would love to know, anyone out there, if you've ever seen any papers published with higher numbers than that. But if you're ever looking at your scores and you want to know, I'm good, but how good am I? Those are the metrics to go after. For a man, if you get above 1.7, I'll be impressed. For women, you get above 1.5 at any age, I'll be pretty impressed as well. But that said, for the average person, how do we contextualize these scores a little bit better? Well, you want to think about this in terms of progression more than almost anything. From a T-score perspective, remember, T-score is you relative to that standard young, healthy person. If you are going through an intervention and you are looking at your T-score and you're trying to make some change, and then six months later you get it measured again, what you want to see is that T-score may or may not improve, but you don't want it to go down.

Dr. Andy Galpin

If it is holding tight, what that's actually meaning is you're improving. So it's a little bit of math trick there, but that's really what you want to see. So when we don't see increases in the T-score, I don't get super concerned about it because it is relative to that age person, and you've gotten older now. So a T-score the same is actually meaning that your bone is holding on, which is great because remember, most people's bone is going down. So the fact that you're maintaining is itself a gain. It's progress, right? The total concentration is something we would look at if we're getting that on a report. If our total concentration is going up, then we know we're going in the right direction, even if our T-score is not. The Z-score, though, the you relative to you at the same age, should be improving. So a little bit help to pay attention to how to interpret those things when you get your results back.

Dr. Andy Galpin

Last thing I'll say about this is in terms of how frequently you test, every six months is probably pretty good. If you want to actually do it every year, I'm okay with that. Bone turnover is slow. So that's what we should be paying attention to. That's what we should test. That's how we should test it, and that's how we should interpret it. Now let's talk about how do we do something about it? How do we intervene? What do we know? What should we do? How much it's going to work, and how should I employ it? Today's episode is sponsored by Momentous. Momentous makes the highest quality supplements on the market, period. Many of you know me, and you know that I do not trust the vast majority of supplement companies, and for good reason. Many studies have shown that anywhere between 10 to up to 40% of supplements have accidental contaminants, intentional alterations, mislabeling, or other serious issues.

Dr. Andy Galpin

But Momentous is different. I literally spent years vetting the company, their products, and leadership team before personally officially partnering with them in 2023. Every single one of Momentous's products is third-party tested to ensure quality, and many are even NSF certified for sport. Now, while I love all of their products, the ones I use the most, both personally and with my clients, are what I call the big three, and these are the omega-3 fish oil, creatine, and newly improved whey protein formula. These three supplements have fantastic data supporting their benefits, and they have been shown to be very safe across basically all populations of people, young, old, men, women, et cetera. Now, nobody has to use supplements, and I hope you never feel pressured to do so. But if you're interested in supplements, it's important that you get them from the highest quality providers. So that's why I stick exclusively to Momentous.

Dr. Andy Galpin

If you'd like to give Momentous a try, 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 Renaissance Periodization. If you want to put on muscle through science-backed training programs, look no further than Renaissance Periodization. Renaissance Periodization guides users through effective and easy-to-follow strength training programs all through their hypertrophy app. These programs are designed by the absolute best in the industry, including one of my favorite sports scientists and professional bodybuilders, Dr. Mike Israetel. You may recognize that name because I reference him and his work countless times over the years. Whether you're looking to put on muscle, gain strength, or both, these programs will help you achieve your goals and have produced results in thousands of men and women.

Dr. Andy Galpin

Renaissance Periodization also has a diet app that is backed by the latest science and innovation in the field of nutrition and takes the complexity out of dieting, helping you achieve your ideal body composition. If you'd like to try Renaissance Periodization, go to rpstrength.com/perform to save up to \$50 off your subscription. Again, that's rpstrength.com/perform to save up to \$50 off of your subscription. There's a necessary caveat I need to talk about here, and it's always true, but particularly relevant for bone health. It's what I call the evidence versus action continuum. The way you want to think about this is for you in your personal scenario, how much evidence do you need to see before you take action? And I'm saying it this way because it is different for everyone. If you, on the individual level, are trying to improve your bone health, you may not require as much evidence for things to have as much of an impact.

Dr. Andy Galpin

A lot of people have the philosophy of saying, "Hey, if it's not dangerous or negative and there's

many things I can do, I want to do as many of them as possible, even if they have a small impact." And that's up to you to decide, where somebody who's maybe a medical physician might say, "Hey, there's not enough evidence for me to recommend it medically," or, "There's evidence, but it doesn't have a huge impact. Therefore, I'm not going to give it a medical recommendation." That's maybe a different barrier. And then even higher up that is things like insurance coverage. So what they might want to see in terms of evidence for either quality of evidence, amount of evidence, or effect is almost surely different than what you might want to see on the individual level. Really important that we go over that right now because we're just not going to see the same level of impact on bone that we see in other common areas.

Dr. Andy Galpin

It would not surprise me to see somebody improve muscle mass by 10% in a few months or to lose 40 or 60 or 80 pounds. You're not going to see somebody double their bone mineral density, or you're just not going to see numbers like that. And so we have to really shift what we think is actionable or non-actionable or worth it when it comes to changing and improving bone mineral health. You will see this is treated medically a lot of different ways with a lot of positive benefits. There are estrogens. There are SERMs, not SARMS, but SERMs. The most common one by far are what are called bisphosphonates. So bisphosphates are super common. It's by far the most recommended medication for bone health. It slows down bone turnover by forcing those osteoclasts, the red to undergo apoptosis. So remember earlier when I said, "Hey, when you start going through menopause, estrogen crashes." And the biggest thing that that causes is because they're keeping those clasts in check, that those clasts run wild.

Dr. Andy Galpin

And so it makes total sense from a medical perspective then, independent of treating estrogen, which you may or may not be doing, to simply give you a drug that stops those osteoclasts. And this is what those bisphosphonates do. So really effective, really well demonstrated, and again, used really, really, really commonly. The problem with it is not everyone wants to take medications. Not everyone has access to these things. They're pretty expensive. They have a pretty well-documented history of drawbacks. And so I don't want to dissuade you away from taking them. Certainly, again, I'm not a medical doctor at all, and I'm certainly not your medical doctor by any stretch. So make the best decision that you see fit with your physician and so on and so forth. But I'm only saying that to say right now, I want to actually talk about all the other options. So for the people that don't want the medications, can't use them, are having the side effects, what other things do we know about?

Dr. Andy Galpin

But I couldn't cover interventions without talking about the most common, most effective, and well-demonstrated one, which is, of course, these various medications. So that said, in my

particular opinion, the best things we can do for bone health are the following. Get it as good as you possibly can as a kid, particularly during those three to four years during puberty. I said that earlier, but I would like to say it 50 more times before we're done today. That's how critical this stuff is. We're really talking about nutrition, but especially talking about movement, exercise, physical activity, whatever phrase you want to give it. You got to move as a kid. You got to move during puberty. But let's be more specific. Physical exercise, specifically resistance exercise in kids, as clear as I can say this, does not stunt growth plates. Lifting weights in kids will not hurt bone mineral density.

Dr. Andy Galpin

It will not make them get shorter. It will not fuse those end plates any sooner or anything like that. I can't emphasize enough how much I want to kill the absolute hell out of that myth. We have known this answer for a long time, and somehow it continues to persist around the world. It is absolutely and fundamentally untrue. In fact, very specifically, many, many studies over tens of thousands of kids, generally strength training, resistance training, weight training, plyometrics enhance bone quality. And most importantly, not only does it do it in that age window, it will last then the rest of their life. Remember earlier when I said what you do as a teenager will determine your bone mineral density the rest of your life. This will happen as well with exercise, strength training, resistance exercise, sports, and everything else like that. So these things are good for kids in general. Obviously, within range.

Dr. Andy Galpin

I don't want you to overuse kids. Don't burn them out. You can do too much physical activity. All those things are true, right? What we're talking about is responsible exercise, supervised strength training, making sure kids are playing and still having fun, and all of the necessary caveats that should be there. Of course, kids can get hurt when they lift weights. Of course, you can do damage. But in general, these things are not only okay and safe, they're incredibly productive for short and long-term bone health. I can't be more clear on that point. There is evidence that simply being active, kids that are physically active, think about this in terms of a study where you simply ask kids about how active they are. What does active mean? Whatever they want it to mean. Okay, so just being active. Over 90% of studies that have been done in this area find positive benefits with activity and bone mineral density.

Dr. Andy Galpin

It doesn't matter if we're looking at randomized control trials, intervention studies, cross-sectional, longitudinal, questionnaires, retroactive studies. You smash them all together, 90% of them find positive associations between more active and more bone mineral density. Again, obviously, that can be taken to an extreme where you're too active, but you get the point here, right?

Dr. Andy Galpin

Very directly, active kids between the ages of eight and 15 will have 10% more bone mineral density by the time they're in their 20s and 30s. 10% more when they're more active between age eight and 15. So again, you're really laying the foundation for what they're going to deal with the rest of their life. The benefits that we see with physical activity seem to be accelerated more specifically with sport interaction, and it's actually by a large margin. Somewhere between 10 to 16% of the difference in bone mineral density in kids who play sports versus those who don't. So if I were to take kids that are generally playing sports versus kids of the same age that are not playing sports, we would expect, again, a 10 to 16% increase or greater amount of bone mineral density in those kids playing sports. So keep your kids active. Get them playing a lot of different sports and activities. If then on top of that, as a third area, you want to add in what I'll call formal exercise, then that's great.

Dr. Andy Galpin

This is when you're intentionally exercising, intentionally having them lift weights, or intentionally doing things like that. That's great. But the reality of it is, I firmly believe if your kids are active and playing, again, a very open definition of sport, that's probably going to be everything that you need. The one thing I will emphasize here is most of the research and most of the benefit tends to come from jumping and landing. Remember Wolff's law. In order for a bone to increase or to be stimulated, you've got to place a large demand on it. You need actual structural pounding of the bone itself, or you need the muscle to be contracting at a rate where it's really ripping on the bone. Not a slow, controlled contraction. All right. So either the weight itself has to jar up and down and create axial loading on the bone to stimulate it, or a muscle or a tendon or connective tissue has to be directly pulling on it rapidly and aggressively.

Dr. Andy Galpin

So most of the studies here are plyometric-based, which just further emphasizes our point. Plyometrics themselves are not dangerous for kids. In fact, they're generally very beneficial. You've gotten the point by now. Let's go ahead and move on. What do we know about exercise after this puberty? So now we're generally thinking, "I've gotten into my 20s, 30s, or more, and now I got low bone density. How do I get it back up?" What do we know? Well, exercise studies still work. The magnitude of effect is smaller, to be totally honest. It's generally still statistically significant and clinically meaningful, but the numbers you're going to see there are somewhere between point three to 2%, which is again, crazy. If I told you this six months intervention gave you a half a percent increase in strength, you'd be like, "Oh, that sucked." But a half a percent increase in bone is like, yay. That's great.

Dr. Andy Galpin

We're super happy there, right? While the bone mineral density effect is smaller, you start to add

on other things. Think about all the countless benefits of exercise that you're getting from any other variable. But in this thing, you start now getting balance, and you start getting a reduction in falls. So there is a significant reduction in your likelihood of having a fall when you exercise. You're not going to break your bone if you don't fall. And so you're kind of actually keeping your bones healthier from two sides of the equation now, the bone itself, as well as reducing the likelihood of putting your bone in a bad position. It is very, very clear, hopefully I made this argument, that just being physically active as a kid is enough. You can get there. You don't have to lift weights. You don't have to play sports. If you're active enough, you're jumping and playing and doing things like that as a kid, you're probably fine.

Dr. Andy Galpin

As an adult, though, it's not the same story, unfortunately. Almost surely at this point, you're going to have to go out of your way to strength train as an adult. Let's start off by remembering the mechanism, Wolff's law. We're all about stress here, causing adaptation. Where we get thrown off here is it's not the actual load that matters. It is the change in load. So if you are not used to lifting weights at all, if you never run, if you don't do anything that puts a huge impact on your bone, if you get a little impact on your bone, that's enough to stimulate growth. However, if you're already at a reasonable amount of loading, you have to do more than you've currently been doing to stimulate bone growth. It is the change. It is the altering from homeostasis that signals it, not the actual load itself. And this part is critical because what it emphasizes is progression. We have to do certain types of exercises in amounts and progression strategies that continue to challenge it, which means it needs to continue to be overloaded to continue to remodel and add additional bone density.

Dr. Andy Galpin

Those osteocytes that we talked about earlier, the blasts and the clasts, get desensitized really quickly to the same stimuli. It's very, very adaptable. I said earlier in the show that we tend to think about bone as this kind of this inert thing, and it's not. It's highly, highly plastic, and it is paying attention. This desensitization happens really quickly. This is why things like static loads and repetitive low magnitude loads are not osteogenic, unfortunately. They are great for lots of things. They're awesome. But for bone mineral density, bone health specifically, they're just not very effective, if effective at all. You have to emphasize, rather, impact-dependent things. So you can impact the ground. This is landing, jumping up and down and landing. You could do tumbling. I guess you could join a judo class or a jujitsu or gymnastics, something where you're landing and the impact is happening all over the place.

Dr. Andy Galpin

The most common, and where a lot of the research got started here, was actually in tennis players. So some of the original research on this entire understanding of the role of impact on

bone mineral density came from studies in which they looked, and they realized that tennis players had way more bone mineral density in the arm that they hold their racket in. And so you think, really? That tiny little tennis ball that weighs a few ounces? Well, that was enough. Why? Because it was happening rapidly. Smashing, full velocity. That led to the significantly different bone mineral density. We see this all the time in our pitchers and different athletes that have sort of asymmetrical loading strategies. So the ground can be something that you impact. It could be an implement, again, like a tennis racket. It could be simply faster pulling on the bone. So you're doing any exercise or activity, and it's requiring you to snap and pull and change directions or whatever the case is.

Dr. Andy Galpin

As long as that's being done aggressively, then those osteocytes are going to feel, like literally feel that on the bone, and then start adding to that reformation or that bone metabolism process. So now that you understand the concepts we're trying to get after, I thought it'd be helpful to go over one very specific protocol. What I'm going to get into is what's called the LIFT MOR randomized controlled trials. This was all led by Belinda Beck, who's at Gulf Coast in Australia, I think. But the LIFT MOR is L-I-F-T M-O-R. I love it when scientists come up with awesome names for their controlled trials. These originally came out in 2017, 2018. And I'm not going to exaggerate here by calling these groundbreaking. And that's because I remember still as an undergraduate and graduate student being terrified, honestly, of working with anybody older because of frailty concerns. And that's because people would just hammer you.

Dr. Andy Galpin

They would really put the fear of Zeus in you that you're going to break somebody's bones. And so we were terrified of having people lift weights unless we knew for a fact that they had quality bones. Prior to 2017, we had really very little evidence That strength training was okay and safe for people with osteoporosis. And we had very little evidence that it was actually beneficial until these lift more control trials started coming out. These lift more trials, there was a bunch of them, but the one I'm going to focus on right now was, I think, the first one, and it was in post-menopausal women that had known low bone mass. So they knew these women were at risk. They later repeated it in men. Now, the trial itself was eight months long, and what they did is they looked at what they called a higher intensity resistance and impact training, and they compared that to lower impact training. The higher impact training was twice per week for 30 minutes, and it was supervised.

Dr. Andy Galpin

I think it was in the clinic, okay? And what they did is they did five sets of five repetitions at 85% of one rep max. Which is awesome. You would generally think, "What?" When we think exercise in clinical populations, we're always like, "Three sets of 10 at 60%," kind of thing. They said, "No.

We're taking people that we know are at higher risk of fractures and falls. We're doing five by five at 85%, four exercises." I think they did deadlift, back squat, overhead press, and then the impact came with this jumping chin-up exercise. So the people stood below the bar, they jumped up, grabbed the chin-up bar, did a pull-up or a chin-up, and then all the way at the top, let go. Fell all the way back down to the ground, and landed. So they were getting that plyometric emphasis by landing there. So those four exercises took them about 30 minutes. The other group did lower intensity stuff like walking, lunges.

Dr. Andy Galpin

They did front raises and some other bodyweight exercises, and I think the highest they'd let them get up to was three kilograms of load. So they did it a whole, and they did lower intensity stuff. Now, there had been enough studies done at this point that you basically knew the lower intensity was not going to work. We just simply know walking doesn't do the trick for bone mineral density.

Dr. Andy Galpin

Three kilograms is not going to be enough. And then to kind of summarize what found out was the higher intensity resistance impact training stuff, it basically won. There was a lot of measures taken. There was a lot of bone mineral density measures taken. And again, basically all the metrics at-- I'm exaggerating a little bit, but most of the metrics for bone mineral density improved way more in the lifting and landing group than the low intensity group. Strength got better. So this was really impactful because it answered two really big questions, arguably three. One, you're not going to break people. If done properly and supervised, and there's more detail to how they warm people up, and all that stuff's in the paper.

Dr. Andy Galpin

Five by five at 85%, four big exercises, and these people didn't break bones, which in and of itself was enough to shock many people. Number two, it actually was way more effective than the standard exercise programs. The third one I would argue is this translated into other things in life because their legs got stronger. Their up and go time, their sit to stand times, these functional activities of daily living metrics got way better as well. So it translated into other areas of their life, which is impactful. So since then, it's been very hard to argue scientifically that lifting weights is dangerous or something you should avoid for people with osteoporosis. In fact, I think we can say pretty definitively at this point, it's a very good thing to do. So if you're the type of person who likes to listen to podcasts like this and they want an exact number, an exact routine, you can go follow the protocol that Belinda did in her studies.

Dr. Andy Galpin

If you like things more broadly, if I were to summarize the whole field, this is what I'd say the bone health exercise guidelines look like. This is everything from how frequent, how intense,

what exercises, rest, volume, and so on and so forth. So starting us off with intensity. One thing that we know has to happen is the intensity of exercise has to be somewhere between moderate to high. That directly influences our exercise choice. The exercises have to be weight-bearing. You generally want them to be multi-directional because the adaptations are site-specific. In other words, if you do nothing but upper body plyometrics, so imagine doing a pushup and landing with the pushup. You're not going to see any change in your lumbar or your femur or your hips in terms of bone mineral density. The same is true for the opposite. If all you're doing is plyometrics, your upper body won't change its bone mineral density.

Dr. Andy Galpin

It is site-specific. That is really clear from the research. So you want to do multi-directional, total body, different movement patterns, frontal plane, sagittal plane, rotational movements, all kinds of things like this to get all aspects of bone mineral density high. So we got to be intense, we got to load it, and we want to pick exercises that are well-rounded in terms of how I'm getting loaded and in the areas that I'm loading it. If you do that, then all you want to do is try to get as much stimuli on there as you can. What does that mean? Frequency. Can you give me two days a week? Great. Can you give me four? Better. Can you give me seven? Even better. Now, that's not the case for things like muscle growth.

Dr. Andy Galpin

But we're not trying to do that right now. If you want the most amount of stimuli on the bone, then stimulate the most amount that you possibly can. So the more frequent, the better in terms of challenging the bone. If you do those three things, then when it comes to volume and rest and order, you can do really whatever you want as long as it doesn't compromise the previous one. So here's what I mean. If you want to do a set of 50 repetitions and you want to take a 20-second break and do it again, and your heart rate gets really high, and you get a lot of sweat going on, is that going to help bone mineral density?

Dr. Andy Galpin

Probably not, because what had to happen with load? You had to go light for that, right? Because you did a lot of reps and you get high fatigue. And so you probably didn't get enough impacts to stimulate the muscle growth. This is not a game of fatigue. We're not talking about fat loss. We're not talking about building your endurance or your mitochondrial health or anything else like that. We got to make sure the intensity and the loading are there. So as long as your volume, whether this is the amount of repetitions per set, the amount of sets you're doing, the rest intervals you're taking are not taking away from the things that have to happen, then you can really do whatever you would like here. The order of the exercises, same thing. It doesn't matter. Bone doesn't care about order. Not a big deal. You got to be able to progress, which is our last modifiable variable. As long as you can do that, everything else is entirely up to you.

Dr. Andy Galpin

Modify it how you see fit, always customize, always individualize, but make sure you hit those previous concepts, and you should be doing the best you can for using exercise to stimulate bone growth. I'd love to continue on convincing you that exercise, specifically strength training, is awesome, but I think you're getting the point by now. So I'm going to move on to our next big category, and I'll consider these to be things that are cheap or kind of medium price point. And exercise is basically free, in my opinion. So within this category, I'm going to first start off with nutrition and supplements. And there's a handful of things we can talk about here, but first and foremost, and the one that always comes to mind is calcium. Now, it makes sense with what we talked about earlier. As long as your calcium intake is sufficient, then that should preserve it in bone and yada yada. Bone health should stay all right.

Dr. Andy Galpin

So with that in mind, it's easy to have people think that taking a calcium supplement will either preserve bone health or stop it from declining in the first place. Unfortunately, it doesn't really pan out like that. The vast majority of the time, as long as you're kind of hitting medium numbers, something like 800 to 1,000 milligrams of calcium per day, you tend to be fine. Adding a calcium supplement on top of that doesn't seem to have much of an impact on overall bone health. Now, this is another case where it's sort of like if you're in the low end of the spectrum. So say you're in a position of low food quality, or you can't eat it, or a kid won't eat it, or something like that, then going from low to normal, there might be a place. But going from normal to high in terms of calcium intake doesn't seem to make much of an impact. You're probably just going to excrete most of that back out.

Dr. Andy Galpin

Now, in terms of getting 800 to 1,000 milligrams of calcium per day, it's not particularly hard. The biggest places you're going to get them from, most common ones are things like yogurt, cheese, dairy products. I think the average glass of milk has like 300 milligrams. So in passing with most people, if you're eating somewhat amounts of reasonable real food, you're probably going to get somewhat close to that. It's just a threshold issue, right? So if you're getting it in food, you're okay. You don't need it. If you're not getting it, and then this is when supplements would turn to be the case. So I would differentiate the impact of calcium supplements based upon kids and adults. Most part, adults don't see much of an impact there. The data are very mixed to non-impressive. Kids, if it's low, take it. If not, you should be fine. The next thing on our list is actually, surprising enough, protein.

Dr. Andy Galpin

There's a really cool paper that came out quite-- It's actually been a few years now, I think 2019. "Dietary Protein and Bone Health Across the Life Course." It's an updated systematic review and

meta-analysis over 40 years. This one actually catches people off guard a lot. They do not realize the impact protein intake has on bone health. That doesn't seem to be a connection there. They don't understand why. Lots of different things are going to be happening here, but it may, and I emphasize may, enhance bone health by improving calcium absorption, a thing called IGF-1, by increasing lean bone mass or lean body mass itself. And so kind of these like secondary actions tend to be the most prominent likelihood of why protein intake helps with bone health. It also accounts for somewhere in the neighborhood of like 2% to 4% of the overall variance in bone mineral density. So it's an impactful thing, but it is not nearly as impactful as all the other stuff we've been talking about thus far.

Dr. Andy Galpin

Fish oil is another supplement that'll come up really routinely. It's honestly like a pretty similar story here. There's a lot of really good research on animals. Some stuff in human, admittedly, it's more mixed. Some of them have been really impressive. Other ones have been saying, "Ah, okay, there's not much here." It's likely very dose and condition dependent, and I think this theme will run true of just about everything in this category. So you know what I mean when I say that. If they're really bad, the supplement helps. If they're okay in this area, then the supplement probably doesn't have as much of an impact. But like protein, there's so many documented benefits of fish oil. It's just almost a no risk potential reward scenario, so why not? Now, collagen is another one. Remember, the bulk of your bone is made of collagen. There's been a lot of research, well, more recent research on this stuff, looking at things that are called specific collagen peptides.

Dr. Andy Galpin

Now perhaps later you can Google what that means, but there have been randomized controlled trials in women, post-menopausal women, that have looked at these things, and in general, it seems to be pretty positive. Right? Bone mineral density in the spine specifically and femoral neck increased significantly with collagen intake. And I'm pretty sure this was actually done at five grams of collagen per day. That's a really low amount. If you were to get collagen, I know specifically the one that Momentous makes. Momentous, of course, is a sponsor of this show, and I've long been involved with that company personally. I think that their serving size is 20 grams. And so five grams is a very, very modest amount. The fact that they saw benefits in two very important sites of bone mineral density with five grams per day of collagen is really, really impactful. And I think Monumental. I haven't seen a ton of follow-up studies on this.

Dr. Andy Galpin

I'm not exactly sure why, but you could dive into the details of some of this research, and again, I think you're going to be more impressed. This is another one that really surprises people. They don't realize these data are out there, and the magnitude of impact is really impressive. You're

talking about four to seven percent increases in bone mineral density over a 12-month span. So again, they're doubling the length here, so we see more improvement. But as we've been talking about, that's quite a bit. So something I think certainly is worth paying attention to, and considering, again, not a lot of downside. Potentially you could argue that the cost is a little bit high, but that's really it, and it has a reasonable chance to create some benefits here. Now, past this, we've got to leave our comfort zones of exercise, lifestyle, sleep, and nutrition. The next handful of things I'm going to cover are things like the stem cells, biologics, peptides, the gut microbiome I promised a little bit earlier, light therapies, and so on and so forth.

Dr. Andy Galpin

Okay? So let's get into what we know about these, and I'm going to hit them all at a little bit of a high level. But this stuff is what I consider to be, whether you want to think about these as second or third-line options, or just more advanced because they're more expensive, they're less easy to get, we don't have as much detail on them, but enough quality evidence for me to bring them up right now nonetheless. Let's start off with what I'll call biologicals. Okay, I'm going to cover stem cells, PRP, peptides, and growth factors. This is a really cool emerging area. There's a lot of talk always in the biological space, but what do we know scientifically? All right. Well, when it comes to bone healing, what we're now talking about is folding in some of that post-bone break, and how do I get it to heal correctly, and how do I get it to heal faster? Do things like stem cells and PRP have a place in preserving bone mass over time?

Dr. Andy Galpin

I don't know. That's a harder one to argue. But if you do break a bone, can you use these things to come back faster? Probably. Very likely. So here's what we know. When a bone breaks and it has to heal, it's got to go through three separate processes: inflammation, repair, and remodel. We've been talking about this repair and remodel all day. So the step before that is the inflammation, and it turns out the success of that inflammatory process directly explains the success of the bone healing. If that inflammatory process is not enough, if you come in with things like NSAIDs or corticosteroids, you block that inflammatory process. That will lead to worse bone healing. Takes longer, and it won't heal as effectively. You need that, okay? You need that process because you have to activate immune cells. You have to activate what are called mesenchymal cells. So these are called MSCs. We're going to talk about these a little bit later.

Dr. Andy Galpin

But that process has to happen, or bone doesn't heal correctly. At the same time, if inflammation is excessive or so bad because either things like what's called polytrauma. This is an open fracture where your bone broke and then it opened up the skin. You got an infection or something like that, like additional trauma, way too much inflammation. Or you're in a state of

chronic inflammation. This is when we lead to poor bone healing as well. So we can think about this and say, "Okay, a bone broke. What happened?"

Dr. Andy Galpin

If we can mitigate this inflammatory process, we can maximize our bone healing, and this is where these biologicals come into play. So we'll start off first with these stem cells, or MSCs, is the specific version we're going to focus on. Really cool recent research has indicated that if you take these MSC cells and you do what's called preconditioning. You also see this as activated or primed. So these primed MSC cells, which means you basically soak them in a bath of inflammation. You can do this with hypoxia, you can do this with TNF-alpha is one of the most common ones you can precondition them with. You put them in these pro-inflammatory environments prior to putting them in you, then you inject them into you, then you see these massive and regulated inflammatory responses, which is helpful. Now, what these specifically do is these MSCs, these preconditioned MSCs, as well as what's called their exosomes, these things that kind of come after it, promote these osteogenic differentiation into osteoblasts.

Dr. Andy Galpin

Fancy way of saying you can create more osteoblasts. So remember earlier when I said, "Hey, you got to know what growth and repair look like because the interventions we work on tackle different aspects of it." This stuff is, I don't know if it's going to do much to your osteoclast, the red ones, but it does a lot for the blast, the B ones on the back end. It also looks like at this point that it may enhance osteoblast capacity. So you're going to take your immature or non-differentiated stem cells and get them to differentiate to creating more osteoblasts and then making the osteoblasts you have, have greater capacity. If you paid attention to stem cells at all, you know that there's a canyon worth of things we got to go figure out. How do we treat them? How do we dose them? How do we store them? All those things are true here as well. I think, in my opinion, clearly there's something there.

Dr. Andy Galpin

I can't tell you which clinic to go to. I can't tell you which one's the best because most of it is unknown at this point. But because we know that these things can impact osteoblasts so well, clearly there's something there. Now, a similar one is PRP. PRP has been around for a long time, platelet-rich plasma. There has been a lot of evidence, actually, for many years on what we can do with PRP post bone fracture, and it's okay. I would say, in general, it's not the most exciting avenue we can go after. Probably some other places that are of more interest than PRP is maybe a nice way to say it. A more interesting area, in my opinion, are peptides. One of the more common ones is called LP2. You'll see that one pretty often. As always, because this area is emerging, almost all of the research is in animal models or even basic cell culture, and so the numbers don't equvalate. So we see these 15X increases in bone growth.

Dr. Andy Galpin

Well, in a cell or an animal, that's not going to translate into 15X increase in your bone health. So these are ones that we're paying attention to. Probably the ones that are the most documented are what are called the BMPs. These stand for bone morphogenic proteins. Now, the most common BMPs are BMP2, 4, and 7. All of them play a role in bone, but these ones are particularly important for bone growth. You'll see the most evidence on BMP7 and 2. Now, BMP7 is not currently approved for human use as far as I understand it. It's been around for probably over 20 years, but it's not being used there. BMP2 is. That's been approved for over 20 years now, as far as I understand it. It's known to directly influence these osteocytes, so the blasts and the clasts, and looks to be like 80% to 85% of the use is off-label, meaning people are using BMP2 for non-direct use. You don't see this for things like osteoporosis treatment.

Dr. Andy Galpin

Now, this is why I'm bringing it up now. Where you see this are traumatic bone breaks. So physicians are using this to accelerate that bone healing post-break, not something that will impact bone mineral density over the long period of time that I'm aware of, okay? But what's really cool about this is this field sort of took off, and then people took it one step further, and they said, "Okay, if BMPs are helpful, what are impacting BMPs?" And so to make you ultra confused, there's a whole subset of things that are immature peptides that come directly from, most specifically, BMP7. So again, the BMP7 is not being used, but the BMP7 derivatives are the most popular, and some of these have bone-forming properties. By far, the cheapest and smallest one is called bone-forming protein. So we went from BMPs to BFP. If you're glancing across literature, you're going to get confused super fast if you're not paying attention.

Dr. Andy Galpin

But what you really need to understand is we started off with the BMPs. BMP7 had a lot of potential. What's operating best within BMP7? BFP. And it started off with BFP1, then 2, and then even more research on BFP4. In fact, there was a 2021 "Frontiers" paper, which is an excellent high-quality journal, found that BFP4 outperformed the original BMP7. And I would say it is very clear at this point most of the research in this area has drilled in on these BFPs. Another potential option you want to think about is physical heat. Again, we're not talking about saying, "Hey, if you go sit in the sauna, you'll reverse your osteoporosis." I don't think that that's the case, and I certainly don't have any information or evidence to suggest that is. What we're talking about here is using heat applications directly on bones post-break in a surgical manifestation of it here. There's actually been plenty of research on this, and it seems to be very effective.

Dr. Andy Galpin

Heat stimulation enhances the osteogenic capacity really clearly, and there's a lot of

commercially available biomaterials that you can use, and surgeons can use to put on bone post-surgery. That's the general use case here. One study actually in particular I found used heat once a week. I think they did 15 minutes for a month at 45 degrees Celsius or about 113 degrees Fahrenheit, depending on which you prefer. So pretty hot there. Again, not a whole body exposure. This is a direct bone exposure. And they saw significant increases in bone mineralization, and they even directly found new bone forming from the periphery and moving towards the center. There is additional information on this temperature thing, though, and this is actually where we're going to transition across a couple of categories. This line of research is fascinating, but there is a lot of evidence that warmth prevents bone loss via the gut microbiome.

Dr. Andy Galpin

That's right. So warmth, physical temperature, where you live at on the Earth, how hot it is in your climate will impact positively bone health via the gut microbiome. So let me walk you through that right now. So here's how that works. There's a great paper that we'll have full access to if you want to go read it. It's actually open access for everyone to go download on their own anyways. But let me give you a couple of highlights from that paper. First, it's been generally shown that people in warm exposures have improved bone strength into adulthood, and it also seems to prevent osteoporosis in most animal models. So point of evidence number one, it seems to be if you live in a warmer environment, bones tend to be better. Number two, there have been human meta-analyses that show inverse correlations between hip fractures and temperatures. Now, I know that these are not randomized control trials, and when I say that for the record, what I mean is they haven't taken people with osteoporosis, moved them to the equator for six years, or two years or whatever, came back and looked at their stuff.

Dr. Andy Galpin

Inverse correlation just seems to be, hey, when we look at people who generally live in warmer climates, they seem to have better bones and less osteoporosis than people who are in colder climates, right? That's only correlation, and we know correlation is not causation, but we're starting to build a bunch of evidence in the same direction, which It's just another piece of evidence for our overall mystery we're trying to solve here. So that's the second thing to pay attention to. Third one is there have been studies that have looked at transplantation of warm adapted microbiome or microbiota, and that can prevent bone loss. Here's what I mean.

Dr. Andy Galpin

You can take an animal from a warm temperature, extract their gut microbiota, put it in another animal. That animal then, the second animal, will see preventions in bone loss. And so something that was exposed via the temperature in the original animal caused some changes in the gut microbiome that were then able to be transplanted to another animal that ultimately all the way preserved bone loss in that secondary animal. If that doesn't demonstrate the impact

and important, I don't know what other stuff you could be looking for. Of course, we want to see it. Does it hold true in humans? May or may not, but pretty awesome to think about. Okay, fourth thing here is those other studies I just mentioned. We know that warmth, direct heat application enhances production of polyamines and things like that, that increase bone strength. And so when you combine all this literature together, I think it's a pretty compelling story that there is something here.

Dr. Andy Galpin

Are we at the end of this research line? Do we know all the answers? No, but it's enough for me to pay attention to and enough for me to bring up in this podcast so you can infer from that what you will. If this area fascinates you as much as it does me, you can do a couple of things. One, just Google gut-bone axis and then see all the papers that come up. Two, there's a couple of papers that we'll directly link to in our show notes. One of them is called "The Brain-Gut Axis," a neurodegenerative disease. It covers a bunch of different stuff here. Another one is called "The Microbiota-Bone Axis in Aging-Related Bone Diseases." And what they're going to show and talk about a little bit more, that I just don't want to get into right now, are how. What is a direct connection? What is being changed? What is being produced out of the gut microbiome that's influencing things like cortisol, influencing estrogen, influencing parathyroid, and mineral deposits?

Dr. Andy Galpin

We know that's the mechanism. So what's coming out of the gut that's changing and altering behavior of our class and our blasts, and these papers will walk you through that. The more we start to learn about how these things like short-chain fatty acids regulate inflammation, how when we modulate these class and these blasts, and they regulate with enzymes like TPH1, and 5-HT, which influence things like serotonin, of course, bile acids, it seems to be pretty clear that there's going to be a strong relationship, and then eventually likely there'll be intervention steps we can take for the gut microbiome and overall bone health. I want to move on now and talk about the little bit of evidence we have for things like light and photobiomodulation. Now, if you look into this, actually, where I would turn your attention to first is what's called low-intensity laser therapy, or LILT. A lot of times we call this colloquially in the field cold laser.

Dr. Andy Galpin

These seem to work. There seems to be evidence there. There's not a ton of evidence. We need more, but that seems to be a reasonable thing to think about. There is much more evidence on the PBMs, the photobiomodulation. If you want to think about this as red light therapy, you can. Lots of stuff in the area of red light for bone healing. There's at least eight studies that I'm aware of, and what's interesting is most of this comes from the dentistry world. So whether this translates into the rest of your bones, I think it will. I think it should, but I can't say that definitively

at this point. Of the eight studies I pulled up, seven of the eight in humans found improvements and in healing with red light therapy or photobiomodulation. Frequency is everything from every day to even every other day. Duration, generally, you're looking at 10 to 20 minutes. If you want to learn more about that, I encourage you to check out the links in our show notes.

Dr. Andy Galpin

And so that said, I'm going to move on and talk about one of our last categories, and that is what I'll just call electricity. And this is everything from the e-stimulation, like the Catalyst suits or other various things like the Marc Pro unit I've used in the past before for other things.

Dr. Andy Galpin

There's a growing amount of research on PEMF, which people have been talking about recently. That's come up. And then there's even cool things like electrically based nanobots that are being used and explored, and that stuff seems to be very promising. Okay, so one paper I would bring your attention to is called "Focus on Bone Healing: New Strategies for Improvements of Bone Healing." One more time, this is probably not for osteoporosis. This is most likely to be accelerating post-broken bone. In general, what you'll see is electrical stimulation has pretty solid potential. I think that's fair to say. But it is high cost. It is inconvenient. The results are admittedly a little bit inconsistent. And it's hard to have a wide applicability. Getting into a PEMF is cumbersome, and these are challenges, but there's stuff here. So you can take a look at the ones specifically. There's a handful of papers that have been coming out, and I would anticipate more coming out on PEMF, and different electrical signals that we can put in the body.

Dr. Andy Galpin

But I actually think that if I had to predict, something's going to be there eventually. So we covered a lot of ground in today's episode, and if I could summarize it, I would say this. Number one, prevention is by far our biggest weapon for bone health. What this mostly means is exercise, human movement, sports, or however you want to think about it, and high-quality foods, especially in and during the puberty window, and especially in girls. Outside of that, if you just avoid the big seven modifiable things that take away from bone health, you're probably in a pretty good spot. Okay? As a quick reminder, those big seven are environmental toxins, various diseases, drugs, medications, sedentary activity, malnutrition, chronic stress, and bad sleep. There are other things that can contribute to it, but these are the big ones. All right? If, though, for whatever reason, you missed the window on that and you've found yourself in a situation in which your bone density is lower than you'd like, it is never too late.

Dr. Andy Galpin

The rate of improvement is modest, but it is meaningful. If you put in a lot of work and you're really focused and you got a trainer, or you started making all these changes, and then you got another scan a year later and you only saw a 3% improvement, that mattered. That's what we're

looking for. You should be happy and ecstatic and excited about that 3% improvement. It's unrealistic to expect 50 or 20 or 80% changes there. So the improvements are small, but they matter a ton. In final conclusion here, if I lost you with some of the technical details, if you're sitting here thinking, "I just listened to a couple of hours of this show, and all he really told me was make sure I don't lose bone mineral density when I'm a kid and then be active," that's fine. I would just ask that we can share this message and bring awareness as much as we possibly can. I love muscle. I'm a muscle guy. I love performance.

Dr. Andy Galpin

I love sports. But bone never gets its due. It never gets the emphasis that it needs, and it arguably impacts more people than any of the stuff that I'm more passionate about. So spread awareness, have people think about it, have people get tested, or at least start talking about it and thinking about it, and doing the best they can with whatever limitations that they have, whatever they're willing to do and capable of doing and have access to. If we can start making an impact on bone health, we're going to impact all of our lives for a long time. Thank you for joining for today's episode. My goal, as always, is to share exciting scientific insights that help you perform at your 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.

Dr. Andy Galpin

And on Apple and Spotify, you can leave us up to a five-star review. Subscribing and leaving a review really does help us a lot. Also, please check out our sponsors. The show would not exist without them and their exceptional products and services. 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 my best to read them all and to see what you have to say. I use my Instagram and X profiles also exclusively for scientific communication, so those are great places to follow along for more learning. My handle is @drandygalpin on both platforms. We also have an email newsletter that distills all of our episodes into the most actionable takeaways. We have newsletters on how to improve fitness and VO2 max, how to build muscle and strength, and much more.

Dr. Andy Galpin

To subscribe to the newsletter, just go to performpodcast.com and click Newsletter. It's completely free, and we do not share your email with anybody. Thank you for listening, and never forget, in the famous words of Bill Bowerman, "If you have a body, you are an athlete."