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Hello, and welcome to Supplementing Health, a podcast presented by Advanced Orthomolecular Research. I'm your host, Dr. Paul Hrkal. This show is all about applying evidenced-based and effective dietary lifestyle and natural health product strategies for your optimal health. We are going to feature some very engaging clinicians and experts from the world of functional and naturopathic medicine to help achieve our mission to empower people to lead their best lives naturally.

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[1:12] Welcome back to Supplementing Health. As always, Dr. Paul Hrkal, here, as your host. Today's topic is probably one that I'm most excited about because it's a nutrient that I've been on record saying that it's my favourite nutrient. As you know, it's magnesium. In my practice, I have five or six different types of magnesium – not different brands or different products, but actually different forms of magnesium.

[1:46] With such a simple mineral that probably everybody is familiar with, it's going to be valuable for us to understand about how do we get the most out of this mineral? It's one that you've probably tried, or you're on currently, or maybe you're considering taking. So this topic, which is going to be broken down into two episodes because I just won't have time to do justice and get in the detail about how this powerful mineral is so incredibly important to almost every single aspect of our health, and I really do mean that.

[2:22] To really understand that we're going to understand how it works in the body and what it does. I'm a big believer in when you understand biology, when you understand physiology, when you understand what magnesium does in the body, it all falls into place after that knowing how it's applied. So if you understand the path of physiology and the biochemistry, it leads into the expression of disease and expression of symptoms. So that's where we're going to start with magnesium today.

[2:54] Today is a solo episode, and this is one that I'm happy to embark on because this is an area that I've spent a lot of time in understanding, so it definitely is something that hopefully everybody will get a lot out of. So, let's jump right in.

[3:07] A good way to break down magnesium is first understanding, yes, it's a mineral. This may be a bit of a blast from the past for some people, and bring them back to their high school

biochemistry even, and maybe first-year undergrad or college biochem classes, but understanding that magnesium is a mineral, and it's from the left side of the periodic table.

[3:33] Those minerals have certain properties, and similar to calcium, and potassium, and those minerals, in general, are alkaline minerals. They have an alkaline property to them, and the function that they have in the body is to regulate acid-base balance. We'll talk about that as it applies to physiology, but it's good to understand where it's coming from.

[3:59] There are four main areas in the body that magnesium plays a key role. The first one we're going to focus on is energy production. Again, this brings back to biochemistry. I remember learning this vividly sitting in, I believe it was Mr. Kepler's grade ten science class, but talking about how energy and ATP, which is the currency of energy in our bodies, how it is made.

[4:30] Magnesium is a central molecule, a central mineral in that ATP molecule. So think about it this way: you need magnesium for every little unit of energy that you make, for every molecule of ATP. If you happen to be deficient in magnesium, which we're going to talk a lot about very shortly. You can clearly see how you're going not be able to make as much of your ATP. So, breaking it down in that very sense, ATP powers every single function in the body, almost, and you can't survive without that energy. Basically, you're the product of your ATP stores.

[5:10] Magnesium is really important for both aerobic respiration, which is using oxygen. So if you're just sitting and listening to this podcast, maybe driving somewhere, you're using aerobic respiration, so oxygen is in ample supply, and that uses mitochondria. These little organelles, these little power plants inside of our cell will take glucose, sugar, oxygen, and through a series of reactions and a lot of cofactors.

[5:42] Cofactors is where magnesium comes in. These are basically little lock and keys, little steps that have to go along on each process to allow an enzyme to go from step A to step B to step C. So magnesium plays a key role in this process. Ultimately, the combination of this process is to produce an energy. Magnesium and energy production is huge.

[6:09] The second, probably the best-known way that magnesium is used in the body, is for muscle function. Just to get everyone on the same page, magnesium, in the terms of muscle function, falls into a class of minerals called electrolytes. We know things like calcium, sodium, potassium – anybody that has ever gotten a muscle cramp if they've been out in the sun too long maybe playing beach volleyball like I did, was very common for seeing guys keeled over holding their hamstrings. That has a lot to do with their electrolyte balance.

[6:42] But just on a day-to-day function, for any muscle to contract, you are going to have to have calcium, which is usually outside the cell, rush into the cell, which is going to cause the contraction in the muscle cell, and you're going to then have it pumped back out. Inside the cell is where magnesium hangs out along with potassium, and where calcium and sodium hang out

outside the cell. Basically, if you're going to have enough of your magnesium stored, it balances the amount of calcium that rushes in and then gets pumped back out.

[7:17] So, if you're deficient in magnesium, calcium is just going to hang out in the cell longer because one of the key principles and one of the key facts that we now know about calcium magnesium is that there's a relationship between the two minerals. Typically, you can summarize that as the two minerals have an opposing function.

[7:38] Calcium is a bit more of a contractor, so C, calcium for contraction. Magnesium is for relaxation. So, more magnesium usually means more relaxed musculature, where extra calcium is going to be more contraction. Remember, I mentioned calcium contracts the muscles and rushes in the cell? Magnesium then relaxes it. So, in this particular case, bringing it back to symptoms that you might feel, a common symptom of magnesium deficiency and imbalances that you have: muscle cramps and muscle contraction, tight muscles.

[8:14] In my practice, I see a lot of chronic pain patients. You're going to see a lot of tense necks, tense trapezius muscles, which are upper back muscles connecting up into our necks, and muscles throughout the body that are very, very tight. Or maybe if you're going to use an internal example, inside of our vasculature, blood vessels, if you have blood vessels that are contracted too much, so there's too much calcification or calcium buildup, not only do the blood vessels get hard, but also they're not able to relax to decrease blood pressure.

[8:52] So, magnesium, as we'll see in a second, magnesium is a really nice mineral that decreases blood pressure because it relaxes blood vessels. So, muscle function, and by extension, the blood flow, as well, magnesium plays a key role there.

[9:10] Two other key roles, I touched on one of them already. I don't know if you knew this, but magnesium is involved directly or indirectly in over 220 different biochemical processes. This may not mean much, but compared to other minerals and other nutrients where they have a couple of biochemical processes, magnesium by far and away eclipses that.

[9:32] So, one of these roles – many of these roles of magnesium is as a cofactor. I mentioned that in the energy production, but basically, magnesium is the mineral that allows, for example, a protein or receptor, which is the way that the body communicates with other parts of our organs and our cells in our body, magnesium is required for that receptor to receive that signal, to receive that message.

[10:01] A particular one that is very important, again relating it back to something that people are experiencing from a health perspective, is the insulin receptor. Anytime you take a bite of any food, especially sugary food, that sugar, that glucose is absorbed in your bloodstream, and then insulin is secreted to suck that glucose back into your cells. That's where glucose is needed for energy production.

[10:28] Magnesium is required for insulin to properly function, as well as for insulin to be properly produced in the pancreas. So, it's incredibly important for blood sugar production, regulation, and control.

[10:44] Then, finally, nerve signaling. This goes back to the muscle function, but magnesium as an electrolyte, a key signaling mineral, it is important for the signaling of our nerve signals, our nerve transmissions. So the production of neurochemicals, such as in our transmitters, magnesium is very important.

[11:07] These are the four areas: energy production, muscle function, cofactors (320 different processes), and nerve signaling. So, you can see, just if you understood that, you can see how magnesium plays a key role in a lot of really important areas when it comes to our health.

[11:24] Diabetes, cardiovascular disease, chronic pain – these are the three main areas that people are going to see their doctors for. These are three of the main causes of not just mortality, but also morbidity, which is feeling crummy and crappy all the time.

[11:44] Magnesium is invaluable for this. The research actually shows that. There's research on magnesium showing that it can decrease blood pressure: 3 to 4 millimetres of mercury in the systolic, which is the bigger number. Then, 2 to 3 millimetres of mercury in the diastolic, which is the second number if you were to take your blood pressure. That may seem small, but actually, it's pretty substantial if you look at it over time. Cardiovascular medication will decrease it 5, maybe maximum 10, and magnesium is just a little bit right under that, but also very effective.

[12:25] Also, in blood sugar, we talked about diabetes. That's a huge issue, and that promotes other health issues like cardiovascular disease, cancer risk, cognitive decline is a massive one. Brain and nerves, we already talked about that's incredibly important as its role in magnesium: the nerve transmission and the production of our nerve signaling molecules in neurotransmitters.

[12:50] Then, finally, magnesium – I use a lot of it in practice to regulate inflammation, to decrease inflammation. There's research showing that a marker of inflammation called C-reactive protein can be decreased after supplementing with magnesium. Conditions such as brain injuries, which inflammation is a hallmark or even asthma. Those people have been shown to have lower levels of magnesium. There is a 60% reduction of magnesium after a concussion.

[13:18] In asthma, the dilation, of not just blood vessels in cardiovascular disease, but actually are air tubes in our lungs or bronchia, they can vaso-dilate them after supplementing with magnesium. The applications are really wide-reaching.

[13:39] To summarize, there's research in magnesium supplementation and depression, fibromyalgia, headaches and migraines are huge. Again, that has to do a lot with blood flow. It has to do with nerves, so those two areas we talked about at length the influence of magnesium: heart palpitations and irregular heartbeats.

[13:58] Osteoporosis – we're going to talk about this a little bit more. We think of calcium and overlook magnesium when it comes to osteoporosis, but it is very important for bone health. Think of calcium as the bricks if we use a house analogy, and magnesium is the scaffolding. It gives more flexibility and tensile strength to that calcium matrix, and magnesium is a really important part of the matrix.

[14:33] In fact, 50 to 60% of your magnesium is stored in your bones. What you'll notice with magnesium supplementation is that most people will, especially if they're really deficient, will notice an improvement in their muscle spasm. They'll notice their headaches are improved, and this has to do with their blood vessel, usually the spasticity and blood flow. That happens pretty quickly after supplementing with magnesium; I would say, usually, within a couple of days to a week.

[15:05] Then people either stop supplementing with magnesium, but really you haven't corrected a deficiency, and we'll talk a lot about deficiency because that's really important. But just supplementing short-term doesn't rebuild your bone levels. That's where magnesium is stored.

[15:21] I've seen some literature showing that it sometimes takes up to six months to properly increase the levels in your bones because if you're deficient, the body will use what it needs immediately in muscles and tissues, and then once things are okay there, they'll start refilling your gas tank, and your magnesium gas tank is in your bones. Magnesium is extremely important for people with osteoporosis.

[15:45] One other thing to point out about the connection between bones and magnesium is that after calcium, vitamin D is probably the most commonly thought of vitamin or nutrient when it comes to bone health. But magnesium plays an incredibly valuable role when it comes to vitamin D because what it does is it helps vitamin D become active, and it's very helpful indirectly at supporting bone health. So, that is one way that is often overlooked, but magnesium plays a key role.

[16:24] When you get magnesium created inside of your cells, if you're exposed to the sun or if you supplement, you supplement with a form of vitamin D called vitamin D3 or cholecalciferol. But magnesium is then required for it to be activated into its 25 hydroxy, and then 125 hydroxy form. That's the active form, and these are done in the liver and the kidney, and magnesium is so important in this activation. That is a hugely valuable and often overlooked reason why magnesium is important for bone health.

[17:03] Vitamin D, by the way, is important for immune health. It's important for brain function. We're probably going to have an episode on vitamin D, which will detail all the reasons why it's so important and why calling it a vitamin is actually not doing it full justice because it really is a hormone in terms of how important it is for signaling.

[17:22] There are many other conditions that would benefit from supplementing with magnesium. These are just a couple that I mentioned and some of the most common ones. PMS is one that I just thought of off the top of my head that is very common. A lot of listeners that are female may be experiencing that, and that has to do with all the processes we talked about: muscle cramps, uterine cramps, those painful periods, pain before your period.

[17:50] Mood – remember we looked at magnesium for depression, so mood and neurotransmission. That's the other big aspect of PMS. So, magnesium is really helpful for almost every single health condition. Those are some of the reasons why it's working in the body. That's some of the research behind it, some of the health applications.

[18:12] Let's talk about absorption because that's the first place that we're looking at when we're getting it into our bodies. Magnesium is absorbed primarily in the small intestine, and maybe 50% of it is absorbed. So if you're taking a magnesium supplement and it has 100 mg in it, you're probably only getting about 50 mg at best. That's something important to consider. That's actually a very common factor in every single one of your supplements. Like, vitamin C, for example, maybe 20 to 30% of it is absorbed.

[18:51] Those numbers are actually similar or, in some cases, lower in foods. The reason being, in foods, you have things like fibre, fats, and proteins that compete for absorption. So, magnesium, in general, is best absorbed on an empty stomach. The reason being is that minerals require stomach acid to properly take them out of their food matrix and all the different molecules around. So, basically, cut them out, cleave them out, and/or supplements, whether it is a food or supplement.

[19:29] So, HCL, hydrochloric acid is very important. It is so important that – and this relates to the deficiency side of things – that many acid blocking medications like proton-pump inhibitors, which are some of the worst offenders when it comes to creating magnesium deficiency in the body. They come with a warning saying, "Be careful. They can cause serious magnesium deficiencies." Some of them actually have magnesium supplemented and combined with those with acid-blocking medications – not that they're really getting any benefit from it.

[20:01] You need stomach acid, first and foremost, to absorb magnesium. There are also different ways – after it is cut apart and ready to be absorbed – that's in the upper digestive system. Now, when it gets to the small intestine, there are a couple of ways that things happen. Normally, there is a passive diffusion, which is a common way that small molecules, like minerals, get absorbed. It gets absorbed through the single layer of our intestinal wall.

[20:35] Then, there's something called amino acid absorption. There is a particular pathway in the body that takes magnesium and an amino acid that it is bound to and absorbs it. This is a huge innovation and a huge therapeutic pathway that we can use to increase the absorption of magnesium.

[21:05] A small amount of it gets absorbed this way. Most of it gets absorbed through the passive route, but you can use combinations of magnesium and amino acid, like magnesium bis-glycinate or magnesium malate. Glycine or glycinic acid, it's called glycinic acid when it's combined with something else, are amino acids. They're actively absorbed through this pathway.

[21:30] Those are the two ways that magnesium gets absorbed. The amino acid form or the amino acid pathway gives us an option to be extra therapeutic. We'll talk about that in Part 2 of the magnesium episodes.

[21:50] I mentioned a little bit about deficiency. We talked about absorption. It's important to know about absorption before we talk about deficiency because, as I mentioned, many things that block absorption can cause magnesium deficiency. We talked about medication. They are a very common reason why magnesium is so deficient for society.

[22:09] Just a couple of comments about deficiency of magnesium, in general. When a governmental organization called NHANES, which was a really big study within a couple of years ago, looked at nutrients that were being consumed, they looked at nutrients by the general population that were achieving, through their diets, the recommended amounts.

[22:37] They found that only 50% of people were getting the bare minimum of magnesium. Let that sink in for a second. That means, if you're in a room of ten people, five of those people are getting sub-optimal levels of magnesium, and they've been getting that their whole lives or different parts of their lives.

[23:00] Now, the question of who is magnesium-deficient is very easy to answer, and the answer is almost everybody. We simply aren't getting it in our diets. Combine that with the many things vying for the blocking of the absorption of magnesium.

[23:21] I mentioned medications. Certain cardiovascular medications decrease the absorption of magnesium. Diuretics are a common one, which are the first line for hypertension. ACE inhibitors can cause magnesium depletion, which is another cardiovascular, high blood pressure medication.

[23:40] The same thing that magnesium is so effective for, the medications that are given for those things are causing the deficiency of magnesium. That boggles my mind when you actually think about it. I mentioned proton pump inhibitors. Any medication that will block stomach acid, something as simple as antacids: Rolaids, Tums, and stuff that you're popping over the counter will block the absorption of your minerals.

[24:07] And it's not just magnesium; it's all your minerals. It's going to be your iron; it's going to be your potassium; it's going to be your selenium, zinc, all the trace minerals. So, the medications depleting things are a huge issue.

[24:21] The second reason that people are so deficient is that magnesium is no longer present in our food supply like it was in the past. This is what scientists are theorizing because magnesium intakes are so low, as I already mentioned, and there are many cases that so many common health concerns are characterized by magnesium deficiency.

[24:49] The farming practices, especially the big commercial, agri business, they're focused on high-yields. When you understand magnesium, it's main role in fertilizer and in agriculture is to strengthen the plant. I used to work at a tree farm that had a retail outlet, a nursery, and we talked about the fertilizer, and the magnesium number – there are three numbers – the magnesium is the strengthener of the plant.

[25:25] Magnesium is primarily found in plants. It's not found in animal products, so unlike iron, which is found in animal products, magnesium is found all in greens and plants. It is actually the central mineral in chlorophyll so that green pigment that gives plants its green colour and that you can actually buy as a supplement is really rich in magnesium because the central mineral in each chlorophyll molecule is magnesium, where in the animal world, iron is that central molecule in hemoglobin, which is analogous to chlorophyll.

[25:59] You can see that if plants are not getting magnesium from the soil, they are going to be deficient themselves and then when we're eating it, we're not getting the same amount of magnesium that we should be getting.

[26:13] There are a number of other reasons why magnesium is deficient. We mentioned diet, so if you're eating poorly, if you're not eating plants, think of all the people that are eating just processed foods. Think of all the people that are just eating meats and more carbs. They're going to be missing out on those magnesium-rich plants.

[26:35] There is a lot of magnesium in water. A big source of magnesium is actually in water, and when you add in fluoride and filtering, magnesium often gets filtered out. My family hales from Central Europe, and mineral springs were a huge source of minerals, and in general, calcium and magnesium. I'm not advocating for using mineral waters because they can often be high in other things, which we don't want them to be, like calcium.

[27:04] Some mineral waters are very high in magnesium. Those are the ones that have been associated with the most health benefits, and they are throughout the world actually. There are some from Australia, New Zealand, Central Europe. Those particular spas, those particular springs, were always revered for being very, very healing, and they happen to have lots of magnesium in them as well.

[27:30] All these factors are conspiring to decrease the amount of magnesium that we have in our bodies, that we have in our diets. So, when a lot of people ask, "Should I be supplementing with magnesium?" then the puritans will say, "You know what? I get everything through foods." I said, "In an ideal world, absolutely. I think this is the best way to do it." But the reality is, even eating organic, unless you're growing all of your own foods and you're fertilizing your soil, I think

most people that are living in our urbanized world are going to be buying things from larger-scale commercially-grown produce, but you're still not getting the magnesium that you need.

[28:17] Couple that with what if you have chronic pain, tight muscles from studying all the time, or something like fibromyalgia? Now you need extra levels of magnesium and much higher levels. You might have been on a medication for a long time for a different reason that could have depleted your magnesium. Now, you have the need for extra.

[28:39] I'm a big believer that 99% of people need to supplement magnesium to get their levels up, and then maybe you can maintain with diet, but magnesium is so essential that I think it's one of those things that is an absolute must as part of your regular supplemental regime.

[28:59] There are foods that are high in magnesium. Some of them are a key part of my family's stable diet. Pumpkin seeds are one of my favourites – per serving size rather than per amount: pumpkin seeds, black-eyed peas, sunflower seeds, tempeh. Certain cereals do have magnesium; almonds have magnesium, Swiss chard, spinach, flax seeds. If you're looking for some of the highest levels, pumpkin seeds are one of my favourites. From a serving perspective, they're going to have the highest amount of magnesium.

[29:37] That gives you a bit of an idea. I want to end off this episode, Part 1, just talking about some of the symptoms you might be experiencing if you have low magnesium. We're talking about some of the reasons why you're deficient in magnesium. What are the effects of magnesium deficiency in the body?

[29:54] This is, obviously, where the rubber meets the road. You've probably heard of some of these before, and I've mentioned them throughout the episode so far, but just to reiterate some of the common ones: anytime anybody has a headache, anytime they have tight muscles, especially neck muscles, back muscles, spasms, restless legs, that's a big sign that magnesium is probably suboptimal. It could be other things. I'm not saying it's just magnesium, but magnesium probably is part of the picture.

[30:28] Things like mood, anxiety, PMS, depression – magnesium can be deficient there as well. Any sort of heart abnormalities, like an irregular heartbeat. Potassium and magnesium are incredibly important for regulating heartbeats. We're going to talk about that and magnesium supplementation in Part 2 of this series on magnesium.

[30:53] I mentioned cramps already. Any sort of cramps after sports, potassium and magnesium are really important. Any sort of cramps of the blood vessels, vasculature, so think of things like poor circulation, blood flow to the legs and feet. Raynaud's is something that comes to mind, and hypertension that I talked about comes to mind. Any sort of artery disease; any sort of diabetes is really, really something that I think of magnesium deficiency. Those are a lot of factors that can really point you to magnesium is very, very deficient.

[31:43] I'll leave you with this interesting tidbit. For every molecule of sugar that you consume, it takes 54 molecules of magnesium in your body to process it. So, if you're consuming a ton of sugar, then you are massively increasing the need for your magnesium. Not to mention, when you increase sugar, you're going to increase the amount of dehydration, urination, out goes the magnesium and other factors.

[32:13] Magnesium is incredibly important. It's central to almost all of the health systems, so hopefully, now, we're all on the same page of that. Most of us are deficient. Almost every single health condition could benefit from using magnesium.

[32:25] In Part 2 of this series on magnesium, we're going to dive into how to get the most out of supplementing with magnesium, some of the pitfalls that people look at. What are the forms that are going to be most specific to the conditions that you are concerned about, and how do you get the most out of your supplements?

[32:45] Thank you so much for tuning in, and I'm looking forward to continuing this conversation about magnesium in the next show.

** * * Outro Music * * **

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